THE

ELECTRICAL REVIEW.

VOL. LXXXIII. DECEMBER 27, 1918. No. 2,144.

ELECTRICAL REVIEW.

Vol. LXXXIII.] CONTENTS: December 27, 1918. [No. 2,144.

	Page
Greater London's Electricity Supply	617
Nationalisation of Industrial Works in Germany	618
Ruhleben—A Final Survey, by W. E. Swale	619
The Coming of Oil Fuel, by C. M. Bennett	620
Looking Ahead, by "Switchgear"	621
Testing D.C. Meters of the Ampere-Hour Type, by W. Hall (*illus.*)	622
Taunton's National Kitchen (*illus.*)	623
The Use of High-Pressure and High-Temperature Steam in Large Power Stations	624
Diesel Engine Users' Association	624
New Electrical Devices, Fittings and Plant (*illus.*)	625
Legal	626
Correspondence—	
Motor Problems	626
Smooth v. Undercut Commutators	626
National Electricity Supply (Greater London)	626
A Phœnix Dynamo Celebration	627
Wages of Employés in Electricity Undertakings, London District	628
The Faraday Society	628
Business Notes	629
Notes	633
City Notes	637
Stocks and Shares	638
Carbon Brushes: Considered in Relation to the Design and Operation of Electrical Machinery, by P. Hunter-Brown (*illus.*)	639
Frequency Control, by H. E. Warren (*illus.*)	641
Electricity Supply Progress in War Time (*continued*)	642
The Supply of Single-phase Power from Three-phase Systems	643
New Patents Applied for, 1918	644
Abstracts of Published Specifications	644
Contractors' Column	Advertisement page xxiv

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY

OFFICE:—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGREKAY, CENT., LONDON." Code, A B C
Telephone Nos.: City 307; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 2s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z.: Gordon & Gotch, Albert Street; Peter G. Tait, P.O. Box 392.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: Peter G. Tait, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: Peter G. Tait, 273, George Street; Gordon & Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

TO "ELECTRICAL REVIEW" READERS.

Owing to the continued increase in the circulation of the ELECTRICAL REVIEW in recent months, an increase which has become accelerated since the signing of the Armistice, we cannot guarantee that casual copies will be available. The only way to make sure of securing a copy regularly as issued, is to place a definite order with a newsagent, or else to subscribe direct to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

GREATER LONDON'S ELECTRICITY SUPPLY.

THE habit of reporting on the Board of Trade Committee's Report on National Electricity Supply seems to be infectious; to-day we publish an abstract of a report drawn up by the Conference of Local Authorities in Greater London. This Report is addressed to no specified quarter, but presumably is intended for the edification of the local authorities and others concerned in this great question, and of the Government. Like the report of the I.M.E.A., on which we commented last week, but unlike the memorandum of the N.E. Coast municipalities, it endorses the broad principles laid down by the Board of Trade Committee, especially that which urges the necessity of immediate action, upon which we have repeatedly laid stress.

The Conference, it is true, declines to take the Committee's condemnation of the existing system of parochial administration without a protest, advancing the extraordinary contention that but for the nursing of the infant "Electricity Supply" by the large number of separate authorities which shared the duties of its foster-mother, the babe would never have attained to its present "perfected" methods! The Report says:—"It behoves the nation to-day to review the mistakes of the past not in the light of wasted capital, but of experience purchased at a cost from which ample profit will accrue in the future." We are then, to understand that it is to the multiplicity of the errors thus admitted by implication that the industry owes its present state of grace; the more the errors, the quicker the progress. This is an obviously fallacious theory, more especially when it is remembered that of all authorities, the municipality is the most timorous and the least inclined to adventure on any departure from the stereotyped pattern. We speak with knowledge when we say that, as a rule, with rare exceptions, such progress as has been made by municipal suppliers has been due to the large undertakings, and in very many cases could not possibly have been contemplated by the smaller ones which make up the vast majority. Take, for instance, the adoption of three-phase transmission and distribution, an essential feature of the "perfected methods" of to-day; was this developed by a small undertaking? Was it developed by any municipality before it had been developed by companies? Or was it even of British origin? The reply is in the negative in each case. Again, take the adoption of high pressure, such as the 30,000 volts which Manchester is standardising; what aid could this derive from a multiplicity of small undertakings? As a matter of fact, it was the great North-East Coast combination that led the way in this direction by adopting 20,000 volts. Or take the question of steam turbines—were these tried out by small municipalities? Not a bit of it. The claim is a preposterous one; on the contrary, the excessive subdivision of supply areas not only immensely retarded technical progress by damping initiative and enterprise, but also handicapped our manufacturers for long years by depriving them of the opportunity to develop

large schemes and plant, so that they lost the long lead which they at first possessed over all other nations, and it also throttled the infant industry by the low salaries paid—and *paid to this day*—to the station staffs in municipal employ. Whoever penned that astonishing claim displayed colossal ignorance of the history of the electricity supply industry in this country and abroad. The biggest of all the "mistakes" was the excessive sub-division of supply undertakings.

The scheme put forward by the Conference is to establish a purely Municipal Board for Greater London, armed with the powers with which other District Boards would be endowed in accordance with the B. of T. Report. That is the gist of the matter; the remainder of the Report consists mainly of argumentation in support of the proposal, and in opposition to any scheme which may contemplate a measure of compromise with the companies which have borne the burden of pioneering electricity supply, and are guaranteed by Parliament in the retention of their concessions for periods laid down by statute. Clearly, therefore, this Report is intended to undermine the plan which was favoured by the London County Council just before the war, and we may take it that the Conference, on which the L.C.C. has no representation, has thrown down a challenge to the L.C.C and the companies alike. It is rightly agreed that electricity supply, to be economically carried on, must be dealt with as a monopoly; and the Conference means to have the control of that monopoly. There is the usual dig at the North-East Coast companies, and a cry of alarm at the suggested threat of the establishment of one of those "trusts" which, it is admitted, are as yet "*foreign to British industry.*" The recommendation of the B. of T. Committee that large consumers should have representation on the District Boards proportional to their payments is represented as a temptation to the large manufacturing groups to acquire control of the District Boards and put up the prices against themselves—surely a puerile suggestion.

The statement that the B. of T. Committee proposes to scrap the existing machinery wholesale is a groundless allegation, as the I.M.E.A. pointed out; it is utilised to support a scheme for public heat supply with electricity as a by-product, and this leads the Conference into an entanglement with the housing schemes of the Reconstruction Committee, into which we need not follow it; neither need we discuss the Conference's competence to deal with agricultural requirements. Had its Report been confined to the statement of its *conclusions*, we should have found little to criticise in it, for we are in agreement with most of them. It is an undeniable fact that company supply in London has made a very poor showing in comparison with municipal supply as regards the cost to consumers; we have not now space to inquire into the reasons for this condition—there is no doubt that there is a good deal to be said in mitigation of the fact—but fact it is, nevertheless. The estimated requirements of Greater London at a date only indicated as "ultimate," which amount to about ten times the present consumption, deserve attention which we cannot now give them, and we must conclude with the remark that the Conference's conclusions, sound in the main, would have been much stronger if most of the long-winded preamble and fallacious arguments had been omitted.

Nationalisation of Industrial Works in Germany.

Dr. Walter Rathenau, of the A.E.G., who has had much to say about Germany as well as Great Britain and her Allies during the war, has been exceptionally reticent concerning the international situation, or even that of Germany, since the so-called revolution in that country and the conclusion of the armistice. He has now appeared in print again, as reference to our "Notes" pages to-day will show. He is also appearing in a new *rôle* as one of the members of the Commission appointed by the "National Commissioners" to prepare an expert report as soon as possible on the question as to which industrial works should be first expropriated by the State. The other members of the Commission are Prof. Ballod, Prof. Ernst Francke, Dr. Lederer (private coach), Dr. Vogelstein, Dr. Rudolf Hilferding, Karl Kautsky, Heinrich Cunow, and Otto Hué, the last of whom appears to be one of the coalminers' leaders. It is not quite obvious why one of the champions of private enterprise, as represented by Walter Rathenau, should have been chosen to report against private ownership. This is, however, not very material for the moment. What is of importance is the scheme of nationalisation in itself, and on this point we cannot do better than quote from a statement made towards the end of November by Hugo Simon, then Prussian Minister of Finance.

Hugo Simon states that the fact that the "Government" have appointed a Special Commission, in which are prominent national economists who are men of practical economic life and science, proves that experiments as made in Russia are to be avoided in Germany. The object is to examine which undertakings are ripe for nationalisation, and the Commission will then submit proposals to the Government, who will presumably act accordingly. Special importance is attached to the fact that no interruption in activity is to take place through transfer to the State, and the highest aim will be to substitute a well-considered system for the existing unrational method of working. As a personal opinion, Herr Simon remarks that only works which are ripe for nationalisation will be acquired. No clearness exists for the time being as to whether the properties will be vested in the State and the actual working entrusted to the former owners, or whether special syndicates will be formed which will be under State supervision; and it is also possible that entirely new forms may be found. The scheme of nationalisation would apply to the arms and munitions industry, and the supply of electricity, whilst all monopoly products—such as coal, potash, &c., would belong to the general community under any circumstances, together with the cement and brick industries. Even in the case of the merchant trade, certain forms are considered to be of utility to the community, whether in the shape of merchant monopolies or of special State and distribution departments; and in this connection the chemical industry is quoted as an example. It is only intended to nationalise those undertakings which have the certain prospect of yielding profits.

The question of the purchase price of the industrial undertakings is also raised by Herr Simon, who, as will have been gathered from the preceding extracts, is himself a Socialist. But preparatory to expressing himself on the matter of expropriation, he mentions that an accompaniment of nationalisation will be a just distribution of payment. "The large salaries of leading persons," he says, "will be able to fall without danger for the efficiency of the undertakings, in favour of workmen and officials being better paid." The undertakings are not to be confiscated, merely expropriated; although no plans exist at present as to how this will take place. It is thought, however, that compensation will have to be fixed in each individual case; neither the book value nor the Stock Exchange quotation can come into consideration, but solely the value which the undertakings would possess as State property. It is suggested that when the values have been fixed, a nationalisation loan should be floated, so as to provide the means for carrying out the programme, and the shareholders would receive certificates of this loan in exchange for their shares on the basis of the price value of the latter to the State. It is further suggested that the certificates, instead of being handed to the shareholders, might, perhaps, be deposited at an official depôt, in order to prevent a flooding of the market and a depression of the loan quotations, and the migration of the loan to other countries. On the other hand, it would be possible for holders to realise their certificates on making application to the official depository.

The internal situation in Germany is so chaotic that it is impossible to foresee whether the nationalisation scheme has any prospect of being actually carried into effect. At any rate, if the scheme should come to maturity, the leading industrial interests in Germany will only have to thank themselves for the disaster they have brought upon themselves by fomenting the war.

RUHLEBEN—A FINAL SURVEY.

By W. E. SWALE.

Ruhleben Camp is—for Englishmen at least—a thing of the past. Amidst the joys of home-coming, and the blessed charms of a re-discovered civilisation, the memories of those four long years are rapidly fading away, and will soon be but a nightmare fancy. Before forgetfulness finally draws the veil over this most painful period of our lives, it may be worth while to record—for the first time uncensored and unrepressed—some of the work achieved by British Engineers at Ruhleben.

Of the "Technical Circle" mention has already been made in the Review. This very active body of engineering enthusiasts kept its colours flying until the very end, being dissolved only a few days before our repatriation commenced. Ninety-four meetings had been held in all, and a whole host of technical subjects, ranging from wireless telegraphy to electric heaters, from the metric system to scientific workshop organisation, had been exhaustively discussed. A very useful asset to our fund of knowledge was made by the advent of the last Chairman (a director of one of our leading electrical firms), who was captured in the Channel as late as August, 1916, and who was the only one—barring a few recent arrivals from Russia and Australia—who could give us first-hand information about the wonderful work of our colleagues at home. The "Technical Circle," having well fulfilled its object, was disbanded; but many of the members will keep in close touch with one another. The late secretary has a list of the names and addresses of the 120 odd members of the "Circle."

The contemporaries of the T.C.—the local branch of the Marine Engineers' Association—numbering about as many members, were likewise very active, and their work has often been mentioned in the *Journal* of the M.E.A. Several chief engineers—some possessing extra-chief certificates—assisted by trained scientists, organised classes to prepare younger colleagues for the B.O.T. examinations, and a number of junior engineers did excellent work in many technical classes. Not only have the studies pursued in the Camp given them a thorough grounding in the theory of their work, but the B.O.T. officially recognises the value of this study by dispensing with three months of the necessary period of sea-going experience. A large number of marine engineers further pursued the fascinating hobby of model-making.

Apart from such "circles," engineers did a considerable amount of systematic study in the Camp School. A number of professional men and scientists co-operated in running an "Engineering Section," and classes were held, of which many worked progressively upwards from elementary to Intermediate and B.Sc. standards. The subjects taught included mathematics, physics and chemistry, theory of electrical machinery, heat engines, efficiency of prime movers, electrical testing, practical surveying, ferro-concrete structures, &c. As time went on we gradually built and equipped biological, physical, and chemical laboratories. A typical piece of work may be cited as an example of the ingenuity of some of our experts. The "Woollen and Worsted Circle" had for many months been weaving little carpets on an automatic loom of original design, built from scrap material found in the camp, and fed by wool which was laboriously collected from the dustbins in the form of old socks, mufflers, &c. Before use the wool was washed and combed, and, where necessary, dyed with dyes made in their own laboratory by dye experts.

It may not be generally known that the work of the School was officially recognised by many educational authorities at home, who, in a commendable spirit of enterprise, allowed public examinations to be held in the camp. At three different examinations some two dozen students passed the Matriculation Examination of the University of London; and five science students, pursuing their studies further, subsequently sat for the Inter. B.Sc. Examination of London. The writer thinks that this case of students passing University examinations whilst interned in an enemy country is unique.

As a branch of the engineering section, practical classes (with actual working machinery) were held in motor-car driving and kinema operation. Of less importance, perhaps, from the scientific point of view, but certainly of greater general interest, were the many examples of work classed under "Handicrafts." The school had a special section where organised instruction was given in bookbinding, leather and silver work, boat building, and cabinet making. Many beautiful examples of such work will shortly be on view at the Ruhleben Exhibition in London.

But the most amusing examples of resourcefulness, and sometimes almost perverted ingenuity, were to be found among the people—often unorganised and untaught—who "made" things, usually with the meagrest of appliances, simply for the joy of making. The construction of "fat-stoves" offered the first outlet for really inventive genius. In the early days it was impossible to obtain a hot meal otherwise than by cooking it illicitly in one's own box (a procedure which was, of course, "strengstens verboten," and for that reason, universally adopted). The original "Tommies' Cookers" we received in parcels were quickly modified to burn sardine oil, &c., and from these rude beginnings innumerable "patent" cookers developed. Some of the elaborate cooking ranges we built, with multiple-wick burners and using oil, candle-ends, or rancid margarine were really triumphs of the amateur tinsmith's art. Constant fear of raids on cookers—detection resulted in severe punishment—led many inventors to elaborate what one would nowadays call "mystery" designs, in which a complete cooker was disguised as a peaceable "billy-can."

The cooking question solved, the attention of experts was turned to lighting problems. The totally insufficient lighting of most parts of the camp was one of our greatest hardships, and as no representation on our part would induce the authorities to alleviate our situation, we took the law into our own hands. The daylight supply was first tampered with. Men living for months in the lofts, in semi-darkness, grew desperate, and fitted glazed skylights into various roofs—with dire results to the unfortunate man who first got caught. But the precedent had been established, and henceforth "day-light" stealing was indulged in in many dark corners. At night conditions were still worse, and in consequence, as soon as we had extended our "underground" communications to such an extent that contraband, like copper wire and insulating tape, could be smuggled in, wire-tapping from the barrack mains became a common procedure. Little transformers—220/8 volts—were designed and built in large numbers, and many men in the lofts soon had their private lighting installations, using the 2- or 4-c.p., 4-volt lamps, which fitted the standard accumulators we were allowed to buy.

Needless to say, these installations were likewise most carefully "camouflaged." The effects of this rapidly increasing "secret" load were of course felt in a general drop of pressure all over the camp, which did not tend to improve the illumination of public space; and when it was discovered that the "perverted" genius referred to above had evinced itself in the shape of an electric toaster and an electric bed-warmer, public opinion rose loud in protest, and cut off the undesirable consumer.

The theatre and kinema, of course, afforded work for electricians, and ingenious devices, such as illuminating switchboards, "dimmers," &c., were constructed there. But the finest example of perseverance and ingenuity in the use of the unpromising material available was shown by the work of electrical and marine engineers in the school compound, foremost among them a man whose name, before the war, was well known to Review readers. The first thing to be built was a 50-watt, 220/16-volt transformer, which was run on the three-wire system, to illuminate the workshops. Several little rotary-converters and D.C. motors were then constructed. For charging up the accumulators used in the laboratories, a simple rotary switch gave excellent results. The climax was reached in a ½-H.P. motor-converter, which was designed to be ultimately used in a lighting set for a car. At a science exhibition recently held in the School laboratories, a complete cycle of transformation, demonstrated with home-made machines, excited great interest. The A.C. supplied to the camp from Spandau Works at 220 volts and 50 cycles was transformed down to 16 volts and converted, by means of a 2-pole synchronous switch, into a hybrid direct-current. This current actuated the motor-converter, which, in its turn, fed a bank of lamps from its A.C. side. Every link in this chain was made in the camp, even down to the end-shields of the big motor, which were cast from an alloy of brass and aluminium scrap, and zinc that had been "obtained" from neighbouring roofs. Many pounds of meat and biscuit tins, as a matter of fact, were converted into dynamo-plates in this department.

Prisoners—like schoolboys—delight in things that are forbidden. Many and wonderful were the methods by which materials and implements necessary for our work were smuggled in. The writer well remembers the pleasure expressed by electrical men on first seeing the Electrical Review in camp, just before Christmas, 1915. In response to repeated, carefully-worded hints, the first copy had essayed the perilous journey, and had safely arrived —cunningly concealed in the false-bottom of a food parcel. For 12 months it continued to arrive in this manner, and only then did we succeed in getting technical papers through the ordinary post. Our thanks are very largely due to the columns of the Review for what we could do to keep abreast of matters electrical.

These brief remarks give but a sketch of the activities of engineers in the camp, but they indicate the nature of the work we tried to carry on. The difficulties in the early days were great, for our captors deliberately hampered our attempts at organisation for purposes of self-improvement. *All* that we eventually possessed we procured, and paid for, ourselves. Then indeed, when the work had been done, our captors would, almost daily, bring round visitors and try to impress them with what Germany had done for the welfare of its prisoners. But we knew better. Even we—who lived so long, on that little island, as it seemed, of Ruhleben—cut off from the world, and isolated by the sea of strife and bloodshed that raged around us—learned lessons from the war. Not the least valuable of these is that we gained a fuller appreciation of one of the secrets of our national strength. The versatility and resourcefulness of the Britisher, left to himself, is in truth amazing.

THE COMING OF OIL FUEL.

By C. M. BENNETT.

It is more than probable that had it not been for the great war, the utilisation of liquid fuel in conjunction with solid fuel would have made as great a step forward in boiler-house practice as did the adoption of mechanically-fired grates over the somewhat crude method of hand firing.

Every branch of science has its milestones of progress, and although some of these are indistinctly marked, green with age, and too often seem more in the nature of resting places than witnesses of progress, the oft-times tedious distance between the last left and the one ahead is eventually overcome.

Hand firing and the use of Welsh coal was the rule, the mechanically-fired grate and bituminous coal the exception. The reason for this was largely due to the fact that boiler-house conditions were not sufficiently studied, the science of combustion did not really interest the electrical engineer, and the use of Welsh coal made the top of the chimney stack appear as if that science was thoroughly understood, and being given the necessary attention.

The great difference in price between the Welsh coal and the bituminous coals was undoubtedly the cause of the examination into the problems of combustion, the conception of properly designed combustion chambers, and the use of mechanical stokers. And with this great advance, for it certainly was such, the general conditions of the boiler house greatly improved, and it can be said that a considerable amount of thought was transferred from the engine house to the boiler house, to the benefit of electrical power production and economy.

The time had arrived then, when things began to settle down with the general use of bituminous coal, and mechanically fired grates.

Although the production of smoke had by no means been overcome, the required conditions were being more and more understood and studied. The demand for small bituminous coals had its effect upon the price of such coal, for whereas in the early days of mechanical stoking in electrical power houses, small coal was abundant, the greater use of such devices brought about a scarcity of coal, and a large increase in price.

This increase in price more than ever brought about a careful study of conditions with a view to further improving the economy of the boiler house, and the saving of fuel.

To those who carefully studied the boiler house conditions, both during a steady demand for steam and a sudden demand for steam during fog periods, it was apparent that there was still something wanting, some addition to the mechanical stokers, to make the whole system of steam raising more elastic.

There are many conditions which make a mechanically-fired boiler sluggish at the very time when its best results are required of it. There are times, owing to the furnace condition as regards temperature, when nothing can be done to get that ready response to steam requirements out of the mechanically-fired boiler.

It is at such times as these that some simple apparatus is felt to be wanting to establish those conditions which will at once make the mechanically-fired boiler the perfect piece of apparatus that it is desired it should be.

This wanting auxiliary to the mechanically-fired boiler can be at once found in the oil-fuel burner, but although this simple piece of apparatus has long been known, it is only quite recently that power station engineers have looked into its possibilities as an auxiliary to mechanical apparatus for the burning of solid fuel.

Just before the war many experiments were being made along the lines of employing oil fuel burners in conjunction with mechanically-fired boilers, and it was noted that not only lower grades of fuel could be burnt, which were otherwise considered useless, but that even with the higher grades better and more perfect conditions were at once established.

If a boiler was hard pressed, due to conditions of combustion not easily corrected at the time, the putting into operation of the oil fuel burners almost immediately rectified matters, and during sudden demands for steam, and even peak loads, the use of oil fuel burners prevented other boiler units being put into operation, just the little extra meeting the demand. In cases where the boiler setting does not give the advantage of adequate combustion chambers, the auxiliary oil fuel burners are of great value, improving as they do the conditions for perfect combustion, and igniting the volatile gases which would otherwise be wasted.

The above remarks show promise that the efficiency of steam-raising plant can be improved by some auxiliary apparatus in the form of oil fuel burners, especially when the furnace conditions are bad, or when the fuel delivered to the hoppers is of an inferior grade. But there are many instances in the best operated boiler-houses when the addition of oil fuel burners would add greatly to the general economy of the plant, and vastly assist in getting the utmost out of the plant, reducing the quantity of combustible matter dumped into the ash pits and enabling a cheaper class of fuel to be used.

Auxiliary oil fuel burners for mechanically-fired boilers can be of a very simple nature, and the whole apparatus requires little or no attention. It is there to be used if the conditions warrant its use, and when these conditions do exist those who have had the advantage of the use of this simple auxiliary apparatus can appreciate its value to the utmost degree.

This milestone of progress has now been reached, and it will not be long before this very necessary and simple supplementary apparatus to coal-fired boilers will be found in every modern boiler house.

It is to be hoped that progress along these lines will now be made, and that the work stopped by the war will again be taken up. The combustion of oil fuel and coal may even mean a great reduction in the weight of mechanical chain-grates, for small grates can be used if the boiler is provided with liquid fuel burners.

The saving of coal and its more perfect combustion is the goal towards which the attention of power house engineers should be directed.

LOOKING AHEAD.

By "SWITCHGEAR."

Now that the war is over, or, at any rate, the armistice signed, it would be wise for electrical manufacturers to consider their post-war programmes, if they have not already done so, with a view to securing trade on a grand scale for this country.

There are many large and reputable firms in the country who manufacture electrical gear; there are also many small firms who turn out good-class work, and it is up to all of them to get their shoulder to the wheel and secure the big trade which undoubtedly will come very soon.

About 20 years or so ago, electrical engineering was more or less in its infancy, for the simple reason that very little was known about it; but as each year has passed, those who have been continuously connected with the business have noticed that rapid advancement, both in designs and manufacture, has been effected.

There is no doubt that "British manufactured" electrical gear is "real stuff," and it is the object of this article to impress upon manufacturers the necessity of still continuing to manufacture good and substantial gear. By their so doing, the users of the goods will be induced to "come again," and it is the repeat orders which pay.

One thing in particular must be borne in mind. When electrical gear is installed, be it generators, motors, switchgear, cables, &c., the customer expects it, and has every right to expect it, to work with little or no trouble, and to attain this end manufacturers should see to it that their wares are perfect and substantial in every respect, and absolutely "it."

With regard to manufacture—"specialisation" and "standardisation" are the words which the manufacturer should bear in mind for his post-war work; for if we Britishers are to have our share, we shall have to look after production on an extensive scale.

During the war—to take one example only, viz., aeroplanes complete with their engines—as everyone should agree, this country has excelled in production and supply. The huge number of machines could not have been completed had it not been for standardisation, specialisation, and mass production. The manner in which hundreds of small firms have specialised on small parts has been simply amazing. With electrical gear it is equally essential, if we are to secure the trade, to specialise and standardise, for by so doing manufacturers can turn out large quantities of what may be termed "units," such as a range of generators and motors (up to a certain size), a range of motor starters, panels, knife switches, various ranges of cable fittings, connectors, &c. In this way they can utilise a good share of the female labour which, during the war, has been employed on munitions; also, it will be possible to buy large quantities of raw material at reduced prices, and thus place on the market large quantities of goods which can be delivered from stock.

In pre-war days consulting engineers and users of electrical gear were sometimes hampered very considerably by having to wait many months for their orders to be completed; this could be obviated to a very great extent if specialisation and standardisation were to be adopted.

With regard to foreign trade, in the past this country has supplied a fair amount of electrical gear to places abroad, but not on the scale that it might have done. Without doubt, in the near future, the electrical business, both at home and abroad, will develop very rapidly, and manufacturers will be wise to look after their interests in this respect. Their representatives abroad should be well educated in the business. In far too many cases, it is to be feared, representatives and agents abroad, although they may be good commercial men, lack knowledge of the design and requirements of electrical gear, and are thus at the great disadvantage of not being in a position to advise clients as to the most suitable type of machine or fitting for any particular job.

Another point to remember is that under the above conditions of working, a great deal of time is inevitably wasted in correspondence.

In the matter of advertising electrical gear we are very much behind, as will be observed by comparing the advertisements in our electrical papers with those in our mechanical papers, to say nothing of the American journals. It is feared that British firms are not quite so go-ahead as they might be, or they would advertise more—and better.

Let it not be overlooked that if we are to secure the electrical trade, we must look ahead.

Electric Vehicle Progress.—A company has been established at Dixon Street, Capetown, under the style of Electric Vehicles, Ltd., to handle a number of leading agencies for electric battery vehicles, which will be sold under adequate guarantees with regard to load-carrying capacity and reliability, together with the provision of an efficient maintenance service. A new idea in connection with petrol vehicles is also being inaugurated, viz., for a fee of 2s. per month the company is undertaking to make fortnightly inspections of the starting and lighting batteries of cars and make minor adjustments, besides replenishing the cells with distilled water where necessary.

TESTING D.C. METERS OF THE AMPERE-HOUR TYPE.

By W. HALL.

The demands of the military authorities have reduced the staffs of most of the electricity generating concerns, and, in a great many cases, the aid of unskilled labour has had to be called upon. Many girls are now employed with the larger corporations and companies, and employment is also being found for discharged soldiers. There is no more suitable sphere for the energies of the foregoing than in the meter department. It has been amply proved that wounded soldiers, with both arms, make most diligent and painstaking meter repairers. The girls at the test benches also soon get to know their apparatus, and carry out the usual tests to the satisfaction of all concerned. These notes, therefore, may be of interest to many who may only recently have taken up meter work, or intend doing so.

Most of the meters at present in use by supply companies are of the ampere-hour type—that is to say, the meter takes account of the current taken by the circuit only, and is independent of the supply voltage. In consideration of the fact that few companies generate much more than their declared voltage, this system works quite well in practice. The mercury meter holds the field at present, and with the type now on the market the error curve is practically a straight line. This meter depends for its action on the passage of the current to be metered through a mercury bath, acted on by the field of a permanent magnet, in which an armature is caused to rotate. A compensating coil to counteract the effect of the friction of the mercury on the armature is added, through which the current also passes. The speed of rotation varies directly as the strength of the current, and this rotation is conveyed to the counting train by a pinion on the top of the armature spindle.

Another meter still in wide use is the commutator type. The principle of action is somewhat similar, only most of the current is shunted off and the remainder passed by means of a commutator round coils of wire on a drum or disk arranged so that at any instant there is current flowing in the coils between the poles of the permanent magnet.

After the meter has been properly cleaned and overhauled by the workman, it requires to be tested for accuracy. Meter testers should strive, as far as possible, to bring their meters within the Board of Trade limits (2½ per cent.) on all loads from full to $\frac{1}{10}$th, since, by careful testing, faults may be discovered, and this will save trouble when the meter is erected. For measuring the current, good ammeters or a good milli-voltmeter and set of shunts are required. These should be tested periodically against standard instruments, and the corrections always applied.

Except in certain circumstances, where a small concern is in question, it is not advisable to test meters by putting them in series with a load on the ordinary circuit. A good battery of 10 or 12 cells should be used, or a low-voltage dynamo. The latter is preferable where a separate room for the cells is not available. The dynamo is separately excited and is driven by a small motor, and the current output is regulated by means of a rheostat in series with the dynamo field, fine adjustments being got by means of a small sliding-contact resistance.

Where only about half a dozen meters are being tested at the same time, these should be connected in series and given a dial run at full load. One ampere-hour will be found sufficient for all meters up to 50 amperes capacity.

$$\text{Time (hours)} = \text{amp.-hours/full-load amps.} \quad \ldots \quad (1)$$

$$\text{Units per hour} = \text{amps.} \times \text{volts}/1{,}000 \quad \ldots \quad (2)$$

E.g., say, 10-amp. meter, 240 volts.

Time of run = 1/10 hour = 6 minutes.
Units per hour = 10 × 240/1,000 = 2·4.

∴ Meter should record 2·4/10 = 0·24 unit in 6 minutes.

Say, meter records 0·244 unit.
Error = 4 in 240 = plus 1·67 per cent.

The meter should now be tested on at least two other loads, ½ or ¼, and $\frac{1}{10}$. A stop-watch test is more satisfactory in this case. All Ferranti and Chamberlain & Hookham meters are provided with what is called a "testing constant"—

$$\text{Const.} = \text{amps.} \times \text{secs./revs.} \quad \ldots \quad (3)$$

Assuming this testing constant to be correct, we have a convenient way of testing. By re-arranging the formula, we get—

$$\text{Amps.} = \text{const.} \times \text{revs./secs.} \quad \ldots \quad (4)$$

Now, say the ammeter indicates that 5 amperes are passing through the meter, and we get 30 revolutions of the armature in 32·9 seconds by stop-watch—

Const. = 5·6
Amps. = 5·6 × 30/32·9 = 5·1

In this case the meter is 2 per cent. fast. The other tests are conducted in a similar manner, the amperes from the formula being compared with the reading of the ammeter.

Meters of larger capacity than 200 amperes can be checked at full load by timing one unit on the counter—

$$\text{KW.} = 3{,}600/\text{time of one unit in secs.} \quad \ldots \quad (5)$$

The KW. are got by multiplying the amperes by a thousandth of the supply voltage. By a combination of these two stop-watch tests, a dial run is rendered unnecessary altogether.

Some of the commutator type of meters give, on the counter, the number of revolutions of the disk corresponding to one watt-hour or KW.-hour. These meters can, therefore, also be tested by stop-watch.

$$\text{Units} = \text{amps.} \times \text{volts} \times \text{secs.}/1{,}000 \times 3{,}600 \quad (6)$$

$$\text{Revs. per unit} = \text{number of revs. taken/units} \quad \ldots \quad (7)$$

This figure can now be compared with that given on the meter. If greater, the meter is fast, and *vice versâ*.

E.g., 8 revs. per watt-hour. By stop-watch 126 revs. in 48 sec.

Amps. = 5·0. Volts = 240.
Watt-hours = 5 × 240 × 48/3,600 = 16·0.
Revs. per watt-hour = 126/16 = 7·9.
Error = minus 1·25 per cent.

This meter is therefore slow, and should be adjusted slightly to make it read correctly.

After the first series of tests it will be found that the meter is in one of the following classes:—

1. All loads from full to $\frac{1}{10}$th within plus or minus 2½ per cent.
2. All loads *uniformly* high or low.
3. Difference of more than 5 per cent. between full and $\frac{1}{10}$th loads.
4. Meters that are sticking on 1 per cent. of their rated full-load current capacity.

1. This case is easily disposed of, since the meter is within B. of T. limits, and can be passed for stock.

2. To illustrate the term *uniformly*, we will imagine the following test results:—Full load, plus 12 per cent.; ½-load, plus 10 per cent.; $\frac{1}{10}$th load, plus 9 per cent. Here we have a difference between full and $\frac{1}{10}$th loads of *less* than 5 per cent., and we see that if, by some means, we can alter the speed the meter will be a good "pass."

In the case of the modern mercury meter, the best way to adjust it is that of "wheeling." This means that one of the wheels in the dial train known as the change wheel is removed, and another substituted in its place, with more or fewer teeth, as the case may be. The speed of registration varies inversely as the numbers of teeth in the change wheels.

$$\text{New wheel} = \text{old wheel} \times \text{average test result/required result.} \quad \ldots \quad (8)$$

So in the foregoing test, if the old wheel had, say, 74 teeth,

New wheel = 74 × 110·5/100 = 81·8.

Where decimals are involved, as above, the lower number of teeth is taken, to be on the safe side for the department.

After changing the wheel, a new constant must be calculated, or ascertained from the constant cards supplied by the makers.

New constant = old const. × old wheel/new wheel. (9)

On retesting, this meter should pass all right.

With the commutator type of meter, adjustment is got by altering the resistance of the shunt circuit. By increasing the resistance of the shunt circuit, more current is forced through the fine wire of the rotating coils, and so greater speed is got, the speed depending on the strength of the current in the coils. After a little practice, the meter tester can tell exactly how much to move the sliding contacts on the shunt for any required result.

3. Often on testing a meter we get results somewhat as follows:—Full load + 2 per cent.; ¼ load + 7 per cent.; $\frac{1}{10}$ load + 8 per cent. Here there is a difference of 6 per cent. between top and bottom loads, and it is obviously useless to "wheel" this meter straight away, since, on retesting, one load would not be within the B. of T. limits. In the mercury meters it is sometimes possible to lessen this difference between top and bottom-load results, accord-

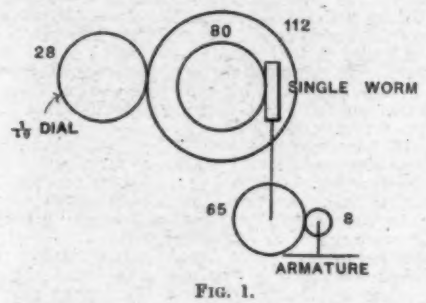


Fig. 1.

ing to the construction of the meter. Thus we have magnets acting on brake disks which, if lowered, slow up the meter at all loads, but *more especially* the bottom load. There are other devices, such as shunt magnet bars, &c., which have much the same effect. Instructions are issued by the makers. So it is possible to "close up the error curve" to the extent that will allow of "wheeling." If there is a pronounced slowing up of the meter from full to $\frac{1}{10}$th load, there is probably a mechanical fault, and the meter should be examined to make sure that everything is free.

4. This class also includes those meters which may not have moved at all during the test, which is possible where a large number of meters are being tested at the same time. Make sure that the locking device for the mercury bath has been freed, and also that the change wheel is not too deeply in gear. No difficulty should be met with in getting all meters to start with 1 per cent. of their full-load current, and no meter should be passed which fails in this test. Cracked jewels are a not infrequent cause of "sticking."

It is most important that the correct constant of the meter should be entered on the test-card, and where the meter has been tested by dial run only, the constant should be checked by putting a known current through the meter and taking a stop-watch test, when the constant can be found from formula (3). A convenient test is to take the same number of revolutions as there are amperes passing, when the seconds will give the numerical value of the constant. This should be compared with the value for the given wheel in the constants-book, and, if within 2 per cent. of it, *the value in the book* should be entered. In any given case the meter constant can be calculated from examination of the gearing. The figures represent the numbers of teeth on the wheels, and the 28 wheel records one unit with every revolution, being connected to the 1/10 unit dial. Say the meter is of 100 amperes capacity, voltage 240—

Units per hour = 100 × 240/1,000 = 24·0

Units per sec. = 24/3,600 = revs. per sec. of 28 wheel

Armature speed = (24/3,600) × (28/112) × (80/1) × (65/8) = 1·08 revs. per sec.

Const. = amps. × sec./revs. = 100 × 1/1·08 = 92·32.

Stop-watch tests should always be made when testing on site, since they are speedier and more accurate. A test-card should be enclosed with every meter, giving number, date of test, and constant, &c. Besides this, the results of every meter test should be properly recorded, and kept in the test room for reference. Every meter should be given a department number, which in itself will show the capacity of the meter—

Meter No. = 173/25·240.

Here the real reference number is 173, but we are also told it is a 25-amp. 240-volt meter.

TAUNTON'S NATIONAL KITCHEN.

We described a fortnight ago the electrically-equipped canteen that has been put down for the benefit of the work-people in a rolling mill near Birmingham, and we now have pleasure in giving some details and illustrations, for which we are indebted to Mr. A. J. Howard, borough electrical engineer, regarding a similar enterprise at Taunton. This time it is a National Kitchen and Restaurant which, on Tuesday, December 12th, was formally opened by Mr. W. Bateson, the deputy director of National Kitchens. With regard to National Kitchens, Mr. Bateson explained in his speech, certain things were essential in order to make them a success. The first essential was that the kitchen should be conveniently situated, the premises must be light and airy, and there must be cheerfulness, as they saw there that day. The whole equipment must be of the best possible kind, and such as would enable them to exercise economy. The staff must be properly attired, and the duties must not be performed in a perfunctory way. They must also see that the portions of food which were given were ample, well cooked, and of a nourishing kind. With those factors there was no reason why a National Kitchen should not be a success.

At the invitation of the Mayor (Alderman H. J. Van Trump), about 65 persons sat down to an excellently cooked

Fig. 1.—Dining Room.

four-course luncheon, served by the kitchen staff, which did credit to Miss Robertson, the supervisor, and the staff.

The whole of the cooking apparatus, including the boiler for heating water for all purposes, is electric, and comprises the following:—Two standard roasting ovens, each capable of cooking 100 lb. of meat, and one grill, by Messrs. Belling and Co. One steaming oven, one 20-gallon boiling pan for vegetables, one 14-gallon boiling pan for milk puddings, one 12-gallon boiling pan for soups, &c., and one hot cupboard, by the Jackson Electric Stove Co. There are also three "Arorn" boiling rings and a "Tricity" oven, which is used as a hot cupboard in the restaurant.

Fig. 1 is a view of the dining room, showing the hot cupboard to the right. Fig. 2 shows the steaming oven.

D

together with the vegetable-boiling pan, to the left, and a grill in the extreme right-hand corner; while in fig. 3 are seen one of the roasting ovens and two of the boiling rings.

The water boiler was designed by Mr. A. J. Howard, borough electrical engineer, and was built by the staff of the electricity department. The heating elements are composed of spirals of chrome-nickel alloy immersed directly in the water in an ordinary 40-gallon galvanised tank, which is covered with non-conducting material, and for which a high efficiency is claimed, "practically 100 per cent." The elements are easily replaced. It has been in

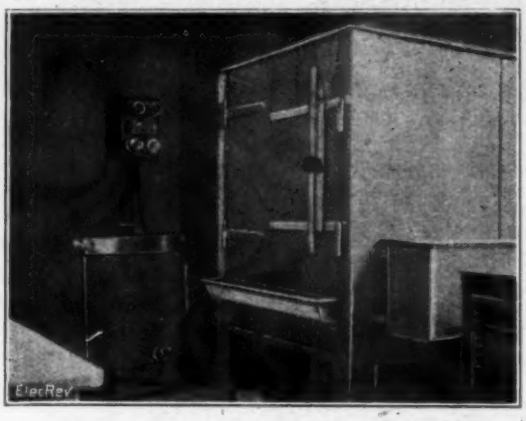


Fig. 2.—Steaming Oven and Boiling Pans.

use since October 4th, and not a single element has failed; it has given entire satisfaction. There are six spirals, the total loading being 10 kw.

Each piece of electrical apparatus is fitted with pilot lamps, and it is proposed to fit ammeters as well. In the week ending December 15th, 3,000 portions of food were served, the consumption of electricity for the week being as follows:—Hot cupboard, ovens, and boiling rings, 385 units; vegetable and soup boilers, including the hot cupboard in the restaurant, 122 units; milk boiler, steaming

Fig. 3.—Roasting Oven and Boiling Rings.

oven, and grills, 146 units; and the water boiler, 358 units. Since the kitchen was opened for public use on October 4th last it has been a complete success, and we are glad to learn that the number of patrons is steadily increasing.

In the opinion of the Food Controller the National Kitchens have filled a public need. There are now in London between 50 and 60, and throughout the provinces from 700 to 800. The Food Department contemplates their becoming a permanent system, and is prepared to make a grant of 25 per cent., and a loan of 75 per cent. free of interest for 10 years, of money required by local authorities desiring to set up new or additional kitchens.

THE USE OF HIGH-PRESSURE AND HIGH-TEMPERATURE STEAM IN LARGE POWER STATIONS.

On Monday, December 9th, Mr. J. H. Shaw, A.M.I.E.E., read his paper (an abstract of which appeared in our issue of July 19th, 1918) at Newcastle-upon-Tyne, before the North-Eastern Centre of the Institution of Electrical Engineers.

Mr. J. W. Jackson opened the discussion, saying the subject was a difficult one to discuss, for they had so little experience to go upon. He raised a point as to Schedule II, which gave a steam pressure at the turbine of 215 per sq. in., and the steam consumption as 9.46 per kw.-hour. This appeared too optimistic. At the same time, he thought the figures for 500 lb. pressure appeared reasonable; but the difference between the two columns was less than they might have expected. As to the steam consumption shown in Schedule III, which gave 11.1 lb. of steam per kw.-hour on the busbars, so far as he had seen that was about the consumption that they expected. As to maintenance charges, it appeared to him they were going through the pioneer work through which they went when they passed from 150 to 200 lb. pressure. He instanced pipe-covering, when they got to a temperature of 650 or so it was difficult to keep the pipe covering on; it seemed to disintegrate, and to require renewing in three or four years' time. The question of temperature also raised the point as to whether they had found the best materials for the construction of valves, &c. As to the presence of oxygen in feed water, he did not quite see why there should be more difficulty in that regard with high pressure than in low pressure. He criticised the suggested use of lap-welded pipes. He mentioned that his firm was constructing a large power station on the North-East Coast of 70,000 kw. capacity with a pressure of 450 lb.

Mr. A. H. Law said that in 1899 his firm anticipated the possibility of the use of high pressure, so far as putting down a boiler to generate at 350, and a superheater for 700 or 800 deg., although they never used those high temperatures except on one experimental turbine, a tandem turbine, but the results were not of any practical interest.

Mr. Dowsing thought that in actual practice steam was more efficient than gas; a way might be found out of the difficulty raised by the author as to the loss in converting water into vapour by re-heating the steam. That might prove a very good solution.

Mr. Shaw, replying to some of the points raised, said the figures given in Schedule II as to the steam consumption of 9.46 lb. per kw.-hour, at 215 lb. pressure, were given by two or three turbine manufacturers as possible and reasonable if purchasers were willing to pay the price. As to 500 lb. pressure, he had got no information at all, and had worked the results out. He did not think any of them need fear the question of maintenance costs so far as pressure was concerned; if there were any trouble it would be due to temperature; with the two combined they might have some difficulty. He did not mean to suggest there was any more air in the condensate at the higher pressure than at the lower, but they had to remember that chemicals were more easily formed at the higher temperatures; furthermore, an absolutely pure water condensate had a greater affinity for air than a condensate perhaps mixed with town water. With regard to the piping, before 1914 he did not think cold-drawn pipes could be bought over 10 in. Now, he thought, they could get 12- or 14-in., but not cold-drawn, so that they had to accept the lap-welded piping.

DIESEL ENGINE USERS' ASSOCIATION.

At a meeting of the Association on November 28th, a discussion took place on a paper read at the previous meeting by Mr. James Richardson on "The Semi-Diesel Oil Engine." (See Elec. Rev., p. 443, November 8th, 1918.)

Mr. George E. Windeler took exception to the title of the paper, as he failed to see why the engine particularly referred to was called a "Semi-Diesel" engine. In the matter of friction, he failed to see why so many piston rings were considered necessary. The design of piston rings was most important, and experience in aero-engine design had proved that the friction due to the piston rings absorbed the major portion of the engine friction. A narrow ring with only a small amount of spring was the best. In the matter of fuel economy, this was higher in the Diesel than in the semi-Diesel, and there was less "blowing down" of the gases, with less wear and tear in the parts of the engine. He could not see the reason for Mr. Richardson's statement that the mechanical efficiency of the semi-Diesel was greater than that of the Diesel, particularly as it had a fixed ratio to the fuel consumption. The great advantage of the Diesel engine was its high economy down to half-load and its capacity for burning heavy fuel oils. In the matter of lubrication there were difficulties with the use of tar-oil fuel, as it was an enemy to lubricating oils. Hot bulbs did not appeal to him for high powers. Good results had been obtained from the use of aluminium alloy pistons.

Mr. T. C. Thomsen considered the question of clearance

with aluminium pistons to be of great importance; he thought that a very viscous lubricating oil was necessary, and remarked that he could not understand how the spray could be too fine. He expressed the opinion that much useful research work could still be carried out in the direction of standardisation of qualities of fuel oil for various types of engines, and with this end in view he thought that more co-operation between the engine builders, users, and fuel-oil manufacturers would be useful. He pointed out that the use of a suitable lubricating oil would considerably assist in clearing away the carbon deposit inside the engine due to excessive temperature of the hot bulb, and he stated reasons in support of his preference for a compound lubricating oil for such purposes.

Mr. Guy B. Petter looked forward to a great future for the semi-Diesel engine, and referred to the rapid progress which had been made, particularly in America, in connection with the use of such types of engine. He referred to the small difference in fuel economy between the Diesel and the semi-Diesel engine, and to the greater simplicity of the latter type.

Lieut. A. J. Mackay gave particulars of experiments which he had carried out with a special form of cylinder head with which he obtained a higher mean effective pressure. He considered that the spray could certainly be too fine; he had experimented with sprays of all degrees of fineness. He spoke very favourably of his experience with pistons of an aluminium alloy.

Lieut. J. L. Chaloner, R.E., considered that pressure was the governing factor in distinguishing between the Diesel and the semi-Diesel type of engine. In the matter of design, the semi-Diesel type was tending towards the Diesel type of engine. He considered the water injection device to be bad practice; it had now been to a great extent eliminated. In regard to fuel consumption he thought that to a great extent this was a question of the class of fuel used. He did not agree with the author's statement that the satisfactory fuel economy attained in the semi-Diesel type of engine was due to the fact that the cycle of operation was nearer to the explosion cycle than to the constant-pressure Diesel cycle.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Simulation of Daylight.

The accompanying illustration (fig. 1) shows a very interesting example of illumination employing concealed source of light, and giving an excellent reproduction of daylight window-lighting effect at the Café Cairo, Dublin. It should be noted that the room shown is entirely underground with entire absence of daylight. For the lighting 100-watt half-watt type Mazda lamps are used, equipped with X-ray reflectors placed outside the windows.

Fig. 1.—Daylight Lighting Effect at Café Cairo, Dublin.

The light is thrown upon white millboard, from which it is reflected through the arctic glass of the dummy windows, producing the effect of morning sunshine which is very pleasing. The hanging lanterns shown are for use at midnight in the event of dances, when the daylight effect is not desired.

The whole installation is an excellent example of effective illuminating engineering work, producing unusual results in a very natural way, and giving a most artistic and attractive effect in interior illumination. The installation was designed by the illuminating engineering department of the British Thomson-Houston Co., Ltd.

B.T.H. "Efracta" Lanterns.

The important requisite for the effective use of half-watt type lamps is scientifically designed lighting equipment. The British Thomson-Houston Co., Ltd., of Mazda House, 77, Upper Thames Street, E.C. 4, is therefore very timely in its announcement of its new types of street lighting lanterns—the "Efracta" and "Diffracta"—both scientifically designed for use with half-watt type lamps.

The illustration (fig. 2) shows the "Efracta" lantern in its open position. This lantern is of substantial cast-iron construction, thoroughly weather and storm proof, and is adjustable so that varying sizes of lamps can be fitted and adjusted in focus in the refractor. The lantern is equipped with the latest type of holophane prismatic bowl (or band) refractor, which provides the most effective combination for securing the wide angle light distribution required in street lighting service. Fig. 3 shows the characteristic light distribution given by this lantern with holophane bowl refractor.

Fig. 2.—B.T.H. "Efracta" Lantern (open).

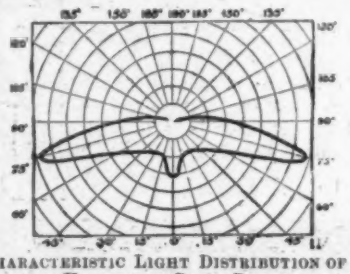


Fig. 3.—Characteristic Light Distribution of Lantern, with Holophane Bowl Refractor.

The illuminating engineering department of the B.T.H. Co. has given special attention to the problems of street lighting, and is willing to assist all public authorities and engineers in the preparation of up-to-date plans, data, &c., for street or other lighting installations.

Copies of the new list, No. 10401-10A/B, will be furnished on request.

A Novel Arc Lamp.

We learn from the *Daily Telegraph* that a further development in arc projection was recently exhibited in this country. It is the invention of a Frenchman, M. Garbarini, and has in small sizes found considerable application in kinematographic projection. But it appears to have a much wider scope of utility. In the new lamp, the end of the positive carbon is centrally disposed within a concentric annular copper ring, which constitutes the negative pole. This ring is water cooled. The arc is struck by a simple automatic adjustment between the positive carbon and the ring. It is then not concentrated at a single point on the ring, but rotates, thus producing a central small crater in the positive carbon, and at the same time distributing the heat over the circumference of the water-cooled ring. No obstruction to the beam of light projected from the small intensely illuminated crater thus occurs, and the light may be projected by any of the ordinary methods. In a lamp of standard size, with a voltage of 55 and a current of 43 amp. or 2,365 watts, a positive crater of 17.6 sq. mm. is formed, with a light intensity of 12,280 decimal candles, or 700 c.p. per sq. mm. The cooling of the annular ring which constitutes the negative pole is automatic by the convection currents of quite a small quantity of water. The feed of the positive carbon is automatic, and is actuated by a mechanism controlled by the current of a thermo-couple; the overall weight is of the order of 20 kilograms or 45 lb.

"Easifix" Shade Carrier.

The accompanying illustrations show the "Easifix Lamlok" shade carrier, by the use of which the removal of a shade for cleaning and other purposes is the work of a second or two, and it is re-attached to the holder in the same small amount of time, a mere twist or untwist of the two little milled-head screws being all that is necessary. The screws are not visible from the distance at which holders are usually seen, and therefore no unsightly

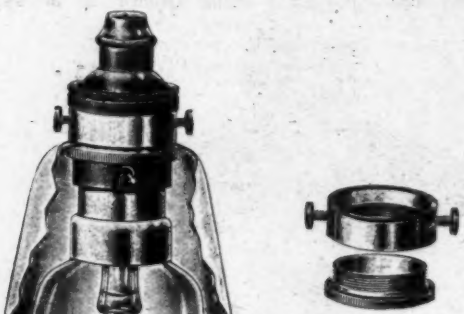


FIG. 4.—G.E.C. SHADE CARRIER.

metal part is introduced by their adoption. The device should find ready acceptance in hotels, offices, factories, &c. We understand that THE GENERAL ELECTRIC CO., LTD., of 67, Queen Victoria Street, E.C. 4, have secured the sole manufacturing and selling rights of this device. Samples of the carrier, together with fuller particulars, can be obtained from the company.

LEGAL.

THE LIGHTING OF A REFUGE.

IN the Court of Appeal last week in the case of Baldock *v.* Westminster City Council, the appeal of the defendants from the decision, as already reported here, of the Divisional Court, was dismissed. The action, it will be remembered, arose out of a charge of negligence on the part of the City Council in not having a street refuge in Cockspur Street properly lighted. The jury in the County Court found that the defendants were negligent in failing to maintain a danger lamp on the refuge; they appealed to the Divisional Court, and failed, as they have now done, in the Court of Appeal.

MOTOR ASSESSMENT QUESTION.

IN the Valuation Appeal Court, Edinburgh, on Thursday, last week, an appeal of interest to the electrical trade was heard.

Included in the amount of £1,151, which was agreed upon as the valuation of the iron and steel works at Craigneuk, near Motherwell, in the event of the assessor being right, was a sum of £9 fixed by the assessor as the annual value of two electric motors, installed in the works. The motors are driven by current purchased by the appellants, the Etna Iron & Steel Co., from the Clyde Valley Electrical Power Co. The assessor submitted that the motors fell to be included in the valuation in respect that they were machines for producing or transmitting first motive power. The appellants contended that the motors neither produced nor transmitted first motive power, and that the first motive power was the electric power supplied by the Clyde Valley Power Co. The Valuation Committee for the Middle Ward of Lanark adopted the assessor's view.

The Court refused the appeal on the ground that the electric motors were machines or plant for producing or transmitting first motive power. Lord Salvesen said that it was not motive power at all until the current had passed through these motors.

Transmission at 140,000 Volts.—The Consumers Power Co. has recently completed a hydroelectric plant in the State of Michigan, which, though rated at only 16,500 KW., is being operated with a transmission voltage of 140,000 over a 100-mile line to Grand Rapids, says the *Electrical News*. Generation is at 7,500 volts, and the 7,500/140,000-volt transformers of 5,000 K.V.A. capacity are of Westinghouse manufacture. On each transformer are 120,000-volt to 140,000-volt taps arranged in 5,000-volt steps. The 140,000-volt oil switches, which are type G 2, 300-amp. units, are non-automatic, solenoid-operated, and set on concrete foundations. The 140,000-volt electrolytic lightning arresters, with their horn-gap structure, are also on concrete foundations and are served by a cone-stack derrick.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Motor Problems.

The ELECTRICAL REVIEW regularly reaches the small West-Country town where I am at present, and I was glad to read Mr. Pickett's contribution on the above subject in the issue of December 6th. I am unable for the moment to refer to the Patent Office records, but I thank him for drawing my attention to the fact that the problem has been attacked.

His statement that my solution does not overcome the difficulty is correct to the extent that the gear is not "fool proof." If I remember aright, the editorial mentioned, or implied, the use of a controller of the barrel type, fitted with shunt-resistance notches. If it is necessary to stop suddenly the quick movement of the controller handle to the off position will first of all cut the shunt resistance out, and give rise to the troubles mentioned. Now a barrel controller implies careful or intelligent operation; given that, the arrangement I suggested will be satisfactory, especially as the controller handle is likely to be the more conveniently placed of the two.

I gather that Mr. Pickett can confirm that some forms of the fluttering relay give trouble, and am glad to note that one form at least is free from criticism. I am still more glad that it is an English production.

Ernest F. Butler.

Bridport, *December 16th*, 1918.

Smooth versus Undercut Commutators.

I have read with very great appreciation your readers' remarks *re* "undercutting of commutator micas." A certain set of rotary-converters with undercut micas gave no trouble whatever as regards commutators when running on a fair load or overload, but when by any chance they were giving no output, or when a neighbouring station began to motor them, they at once commenced violent chattering at the brushes. In fact, we always regarded this as a warning to look out for the reverse-current relay of the circuit-breaker operating. Can anyone suggest the cause of this?

D. F. B.

December 18th, 1918.

NATIONAL ELECTRICITY SUPPLY (GREATER LONDON).

LAST week a "Report on Public Control of Electricity Supply" was issued by the Conference of Local Authorities owning Electricity Undertakings in Greater London, of which Ald. Duncan Watson, M.I.E.E., is chairman, and Mr. Fred. Tait, of Poplar electricity works, hon. secretary. The conference embraces 16 Metropolitan borough councils, two county borough councils, four borough councils, and 13 urban district councils in the Metropolitan area. It is not indicated to whom the report is addressed. As it is a lengthy document, we give below an abstract of its contents:—

The report first quotes the speech made by the Prime Minister on November 16th to emphasise the importance of the subject, and the conclusions arrived at by the Board of Trade Committee on Electricity Supply. Of the latter, the first two, pointing out the necessity of adopting the most efficient methods and machinery, and of largely increasing the amount of power used in industry are unreservedly accepted; the third, stating that the supply to small areas by separate authorities is incompatible with a technically sound system, is criticised on the ground that had not the large number of separate authorities undertaken the supply of electricity when it was in its infancy, the present perfected methods of supply would never have been attained, and the United Kingdom would have been unplaced in the race for industrial supremacy. The fourth conclusion, stating that interconnection alone cannot meet the requirements of the situation, is characterised as "meaningless to the public at large," but it is pointed out that the Board of Trade, having recommended linking-up, did nothing to enforce it, and the report adds that interconnection will go a long way towards meeting the requirements if evolutionary methods are adopted to obtain the cheapest possible supply. The fifth conclusion—that a comprehensive system for the generation of electricity on a reorganised basis should be established as soon as possible—is emphatically endorsed as the solution of the vital problems enunciated by the Prime Minister.

The report states that the municipal authorities of Greater London have recognised the necessity of linking-up their generating stations, and of erecting large super-stations instead of extending existing stations, and it is proposed that a central authority, to be known as the "Greater London Electricity Board," shall be set up to control these super-

stations. The Board will be empowered to raise capital upon the security of the assessable value of the whole area of supply, and all local authorities within the area will have representation on the Board. It is proposed to transfer to the Board the compulsory powers of purchase now vested in the London County Council and other local authorities, and to supply electrical energy to authorised undertakers in and adjoining the area, and to railways, tramways, &c. The policy of the Conference is to secure complete public control with the least expenditure of capital, and at the minimum cost for the promotion of the scheme. It is not proposed at the outset to scrap existing economical stations, but others would be shut down, the future demands of all existing stations taken over, and the remaining loads taken over when the existing plant became obsolescent. It is the desire of the Conference to establish a Board untrammelled by the burdens of capital expenditure in respect of private interests acquired by private enterprise, and to avoid financial pitfalls such as the Metropolitan Water Board and the Marylebone Borough Council fell into. Attempts have been made to obtain private control of electricity supply in Greater London at the cost of compromising with existing private undertakers before the terms of their provisional orders have expired; "*compromises of this nature can only be made either by a huge expenditure of public money or by excessive charges for supply over a term of years,*" and care should be taken that no such compromises are allowed by legislation. The Conference desires that legislation shall be set up to ensure the economic use of coal now and for all time by controlling its use both by private individuals and by public utility undertakings; should the individual be restricted in the use of fuel, the demand for electricity would be enormously increased, and therefore the producers of electricity should also be restricted in the use of fuel in order to obtain maximum economy. Electricity supply is essentially a monopoly; competition merely leads to increased charges through the duplication of capital expenditure. It has been suggested in recent reports that mixed boards, representing public ownership and company control, are preferable to absolute public control, because profits can, by legislation, be limited to moderate rates, but no legislation can limit capital expenditure entered into upon expert advice on which such profits would be allowable. Capital can be multiplied to an appalling extent in numerous ways, as exemplified in "the revelations recently published of the financial operations of certain companies which have hitherto been taken as a model electricity supply combination." Records of the cost of production show that municipal management is decidedly superior to company control, and the public will benefit if private interests are entirely eliminated from the supply of electricity.

Estimates prepared by the conference on the ultimate requirements of Greater London show that over 5,000,000,000 units of energy per annum will be needed, on which a variation of one-tenth of a penny per unit means a sum of £2,000,000 per annum. The primary object of companies is to maintain profits, whereas that of municipalities is to reduce prices to the lowest possible degree. The average prices per unit sold by companies and municipalities of London in the decade prior to the outbreak of war show differences in favour of public control amounting in later years to more than 30 per cent. (1913-14: Municipal 1.77d., company 2.38d.; difference 0.61d.) The minimum rate for a municipal undertaking in 1913-14 was 0.99d. per unit, and for a company 1.09d., the difference being 0.1d.; in the latter case the supply was largely for traction, which was not included in the former. The average price charged in London, which has been maintained at high rates by private companies, has been held up for comparison with those of the principal cities of the world, much to the detriment of London, but in all such comparisons the London traction supply has been left out, rendering the figures valueless for comparative purposes. The operating costs in three East London boroughs in 1913-14, corrected for the price of coal, and compared with those of Berlin in 1911-12, and Chicago in 1911, corrected for "municipal participation," are given as: East London 0.447d. per unit, Berlin 0.454d., Chicago 0.51d. Traction supply is cheaper than general supply, and in Chicago 69 per cent. of the whole output is used for traction, whereas in East London 10 per cent. only is so used. "These figures should dispose finally of the argument that electricity can be produced cheaper abroad than at home."

It is held that although little exception can be taken to the principles of the conclusions arrived at in the Board of Trade Committee's Report, the whole tendency of the report seems to be in favour of company operation in preference to public control, and "the legislation recommended would have the effect of fostering the growth of huge industrial trusts of a nature happily yet foreign to British industry"; the report of the committee recommends that large consumers be represented on the District Boards, with one vote for each £200 paid for electricity, and it is suggested that any one of the great manufacturing groups recently formed could control the operations of a District Board, and as the number of votes would be increased in proportion to the price charged, "the public would suffer at the hands of the trust."

The cost of machinery at present in use by municipal undertakers in Greater London is estimated at 4½ millions sterling, and "the Board of Trade Committee recommends that this plant be taken over by the proposed district board and placed upon the scrap heap, the cost of this manipulation to be charged to capital account, and paid for by money raised at certainly not less than 5 per cent., but probably 5½ per cent. or 6 per cent., whereas on an average the original loans were raised at 3½ per cent." Whilst in some instances an increase in capital charges would be more than repaid by decrease in operating costs, many undertakings could continue to generate under existing conditions at a cheaper rate than could possibly be adopted by the proposed district boards; therefore it is essential that these stations should be utilised during their economic life. Schemes "in embryo" for the utilisation of existing steam-raising plant and buildings as central-heat supply stations, with a certain amount of electricity generated as a by-product, are referred to, and it is urged that the generation of electricity with steam produced by refuse destruction should be continued, whereas the Board of Trade Committee has deliberately ignored this, in spite of expert advice. Under the new housing schemes under consideration of the Reconstruction Committee, the supply of hot water to private users is considered essential to public health.

The question of coal conservation is next dealt with, and it is suggested that if a combined system of power, light, and heat distribution were adopted through the medium of electricity and water on the lines indicated, and restriction placed on the use of coal, the reserves of the country would last another 2,000 years.

The conference concludes:—That agricultural prosperity, improved transportation, industrial power, increased wages, improved conditions of labour, and the health of the people are inseparably bound up in the development of electricity supply under public control. Greater London and its immediate neighbourhood must be recognised as a "district," and provided with a district board appointed by the people, financed on public security, and operated for the benefit of the people only. The cheapest possible supply of electricity is absolutely essential to the development of Greater London as an industrial area, and cheapness can be obtained under public control only, unhampered by watered capital. Each clause of the Board of Trade report should be weighed carefully before acceptance. Regard should be had to the distribution of heat from a central source. The problem should not be considered as a party question. Compromise means inordinate capital expenditure, and consequently excessive charges for supply. Coal should be conserved by restricting its use. Electricity supply is essentially a monopoly, and should not be exploited for gain. Some of the most important recommendations of the Board of Trade Committee leave the door open for financial trusts of foreign origin. Under public control in London production has invariably been at a lower average charge than under company control, and in parts of London the rates have been lower than in Chicago. Existing plant should not be scrapped because inefficient, but retained where possible for central-heat production, and the generation of electricity as a by-product. Public control of electricity supply in Greater London would do much towards conserving the coal of the country.

A PHŒNIX DYNAMO CELEBRATION.

A GREAT social and reunion of employés and ex-employés of the Phœnix Dynamo Manufacturing Co., Ltd., Bradford, took place on Friday evening at the works. The various buildings of the large establishment, as well as the entrances and the passages through the yards to the different places of entertainment were lavishly decorated by cordons of coloured electric lights and masses of bunting, flags, holly, and flowers. The whole place was transformed to a degree beyond the imagination of all except those who had had the supervision of the entire work. The affair was organised by the firm, of which Mr. P. J. Pybus, O.B.E., is the managing director, and the staff. The attendance numbered somewhere about 4,000, many of the guests being in fancy dress, in connection with which prizes were ultimately given. One of the most noteworthy features of the occasion was the way in which plant and productions had been cleared out of the way to allow unhampered freedom of movement of the great crowd of pleasure-makers. The 9.2-in. shell shop, which was the hall of assembly, and the centre of games and music, and the A.V. metal shop, which became a spacious ballroom, presented wonderful kaliedoscopic pictures, what with the massed decorative effect and the happy throng.

The event, which commenced at 6.30 and continued until 2 a.m.—when there was a special service of tramcars to various part of the city—was held for the purpose of celebrating the end of hostilities and of the need for further production of shells. The aircraft work of the firm, it should be mentioned, is being continued. Refreshments were available without charge in the aerodrome women's canteen, which has seating accommodation for about 900 persons at a time, and is run by the firm and the Young Women's Christian Association jointly. The men's canteens, which are under similar control, were not in use. In the A.V. erection shop a concert and kinema entertainment took place, the films shown being partly comedy and partly pic-

tures of the firm's work and productions, a picture of the Prime Minister being received with warm applause. The bands engaged for the evening were the Bradford Police Military, and Mr. Brown's Band from Morecambe Tower and Casino, Mr. Brown himself, one of the best-known North of England experts, being the master of ceremonies in the ballroom.

Mr. P. J. Pybus, welcoming the vast party of guests in the assembly hall, expressed the great pleasure which it gave the directors and himself to entertain their workers who had collaborated during the great war to help in the production of the munitions needed by the Allied troops. He thought he was correct in saying this was the most wonderful Christmas in history. The war had overshadowed everything during the past four years, but it was now over, and over in the right way. Mr. Pybus spoke of the wonderful way in which all departments of the undertaking, along with similar workers throughout the country, had worked together to bring about the triumph of right. He thought he could fairly say, "Well done," and he believed that when the soldiers all returned they would say the same. After referring to the work and productions of the Phœnix establishment, Mr. Pybus said when the idea of a victory celebration was made it was taken up with enthusiasm, and it was resolved to have a "do." He thought it would now be agreed that it was going to be "some do." Mr. Pybus expressed the firm's regret that a good many of the employés would now have to go back to their ordinary peace-time occupations, but they would leave a great tradition behind them which would live for many years. Though the firm were sorry they could not find employment for them all just now, perhaps many of them might ultimately return.

In connection with the celebration a special issue of the *Phœnix Bulletin* was issued to mark the gathering. The issue was profusely illustrated with photographs of the works, of the productions, of the visit of the King and Queen in May, 1918, and of the welfare arrangements, and with cartoons, with letterpress describing the various operations.

The transformation of the great workshops had been accomplished in just over a week, the clearance being necessary in connection with the future operations of the undertaking. Arrangements had been made with the Ministry of Munitions by which, as shell-making was not now necessary, the firm should go on to something more useful. Arrangements for the demobilisation, at a gradual rate, of many of the war-time hands had already been made. The people no longer needed in the shell departments were got to work on the clearance of certain of the buildings, so that the needs of work and the requirements of the reunion synchronised, there being no hall anywhere in the district which could accommodate between 4,000 and 5,000 people at a social. All this big space now provided will be required for post-war work in the new operations of the English Electric Co., comprising the Phœnix Co., Dick, Kerr & Co., Ltd., and the Coventry Ordnance Works, and the associated companies of these concerns, a fusion which will employ 20,000 hands. After the whole of the great assembly had marched in marshalled order before a kinematograph operator, taking half-an-hour over the operation, the ball, concert, games, and kinema exhibition proceeded. In the kinema show the first film was that taken at the works in connection with Mr. Pybus's propaganda campaign earlier in the war, when he toured the country on the question of the dilution of women labour. Another film showed the visit of the King and Queen to the works, and the opening of the women's canteen by Her Majesty.

The Phœnix undertaking has made upwards of 2,000,000 shells, ranging from a six-pounder anti-Zeppelin shell to the 12-in. gun shell, which is the largest in general use in the British Army. As other people got more accustomed to making the smaller shells the Phœnix works turned to bigger types, and have been engaged on the big shells mostly for some time past. The building of the shops in which the festivities took place was a wonderful achievement. The 9.2 shell shop, which was the hall of assembly, after work on the erection night and day, was in such a condition that the first tool was run exactly three weeks after the laying of the first brick. This was in February, 1915. The aircraft shop, which was the ballroom on Friday, was built similarly in six weeks. At the end of 1915 the firm started the aircraft work, making scouting seaplanes of two designs supplied by the Admiralty. Later they got out improved types of their own, and a flying boat of their own design and construction, which they named the Phœnix-Cork, and which was, at the declaration of the armistice, Mr. Pybus claims, the fastest big machine in existence. The Phœnix boats have all been named after some Irish town. The firm have employed about 1,500 people on aircraft continuously. Later, in 1916, it was decided that instead of receiving billets from Sheffield, they should put up a factory and pierce their own, and that was why the works at Dick Lane—forges on the most modern lines—were built on the Great Northern Railway sidings, and linked to the Thornbury works by an electric railway. The firm have all along specialised in the employment of women labour, and have found it a great success. In fact, Mr. Pybus pays the highest tribute to the women in all branches of work. Their operations in female labour have been photographed and kinematographed officially for Government circulation both in this country and in India and the Colonies, and since America came into the war a staff of kinema photographers have visited the place for similar propaganda in the U.S.A. Mr. Pybus is an enthusiast in the work of the firm and in the welfare of the people, and this spirit, along with the welfare arrangements at the premises, has made the output at Phœnix amongst the best in the country. The works are five times their pre-war size, the bulk of the erections having been put up by the firm's own contracting staff. It is expected that the space will be fully utilised by the work under the fusion of companies.

WAGES OF EMPLOYÉS IN ELECTRICITY UNDERTAKINGS, LONDON DISTRICT.

As stated in our abstract of the Committee on Production's Award No. 2,772, in our issue of November 22nd, "pending the setting-up of District Boards under the proposed Joint Industrial Council for the Electric Supply Industry, it is proposed that if any questions arise with regard to:—

1. The intent and application of any award of the Committee on Production.
2. Rates for addition grades;
3. Regrading;
4. General questions;

the parties shall confer after requisite notice has been given and endeavour to arrive at a mutual settlement. Failing such settlement, any matters of difference to be referred to the Committee on Production.

The Committee are of opinion that the proposal is likely to be of benefit, and they will be prepared to co-operate in its adoption so far as it is in their power to do so."

In accordance with this provision, a joint meeting between the employer and union representatives was held at the County Hall on November 27th, when the following were nominated to give effect to the above award:—

Employer Representatives (10).

The 14 London Companies.—Mr. Charles P. Sparks (chairman), Mr. F. Bailey.

The Incorporated Association of Power Companies.—Mr. E. T. Ruthven-Murray.

The Tramways Association.—Mr. C. J. Spencer.

The Suburban Undertakings.—Mr. K. A. Scott-Moncrieff.

I.M.E.A.—Mr. A. C. Cramb.

Conference of Local Authorities on Wages.—Ald. A. G. Beaumont, Mr. A. J. Fuller.

L.C.C.—Mr. A. L. C. Fell, Mr. P. L. Riviere.

Union Representatives (14).

Electrical Trades Union.—Mr. J. Rowan (vice-chairman), Mr. J. Membery, Mr. H. H. Morton, Mr. Westfallen, Mr. T. Goode, Mr. V. Needham.

Workers' Union.—Mr. Small, Mr. J. G. Greenwood, Mr. A. Smith.

National Union of General Workers.—Mr. C. L. Skinner, Mr. Boyne.

National Amalgamated Union of Enginemen, &c.—Mr. J. Meakins, Mr. J. Allen, Mr. W. G. Chapman.

Mr. W. J. Webb, Secretary of the four Unions.

THE FARADAY SOCIETY.

The Occlusion of Gases by Metals.

A most instructive discussion on the above subject was held by the Faraday Society at its November meeting. The meeting, which opened at 5 p.m., was largely attended, and the 30 or more speakers, who kept up a sustained interest in a very attractive subject until long past 10 o'clock, envisaged the points under discussion from every possible point of view. Such a discussion cannot fail to be fruitful in its results.

The President, Sir Robert Hadfield, F.R.S., in his opening remarks, gave a brief historical survey of occlusion, more particularly from the point of view of the ferrous metals. It is noteworthy that the great English chemist Graham, the father of colloidal chemistry, was also the author, so long ago as 1866, of the first scientific contribution on "Occlusion," although previously Bessemer had recognised the importance of removing gases from fluid steel. To this day one of the most important practical bearings of the subject concerns the production of sound steel castings, while other aspects of it range from the passivity of metals and the embrittling of iron to catalysis and the production of high vacua in X-ray tubes.

On the theoretical side the symposium was opened by Prof. Alfred W. Porter, F.R.S., who grouped the phenomena of occlusion under the following heads:—

1. Chemical combination of gas with metal.
2. Simple solid solution of gases.
3. Immiscible solid solution of gases in equilibrium with each other.
4. Solution accompanied by surface adsorption.

5. Surface condensation under molecular forces unaccompanied by solution.
6. Inclusion.

In practice it is often difficult to distinguish between these various types of occlusion. A case in point is the familiar occlusion by palladium of hydrogen, which was discussed at some length by Dr. Porter. The theory of the subject was further developed in a suggestive contribution by Capt. J. W. McBAIN, who showed how the different types of occlusion varied in the time-relationships and in their dependence upon temperature. Thus true *adsorption*, *i.e.*, surface condensation, is nearly instantaneous, while *absorption*, or solid solution, obeys Fick's law, commencing with a very high velocity and then rapidly falling off with time.

Several speakers spoke on the temperature relationships. Dr. W. ROSENHAIN, F.R.S., contrasted the absorption of gases by liquid metals with their solution in ordinary liquids, where solubility decreased with rising temperature. This pointed, he thought, to the formation of compounds of gases with metals which were more stable at higher temperatures. Gases remaining occluded after the solidification of the metals were probably in solid solution, and perhaps held in the amorphous undercooled liquid films bounding the metal crystals. Dr. N. T. M. WILSON, however, pointed out that the decrease of gas solubility in ordinary solutions with rise of temperature was only true of water. Other solvents behaved as did molten metals in this respect.

The important theories of Langmuir were referred to by Capt. McBain and others. Langmuir pictures every atom within a solid as tied to an equilibrium point in a space lattice, but it is attached to all neighbouring atoms by primary or secondary chemical valency. On the surface, therefore, the layer of atoms would present unbalanced valencies on their outer side, and in these are to be found the origin of all surface phenomena. Thus adsorption is the attachment of outside molecules or atoms to the exposed free valencies of the surface atoms. It is therefore due to purely chemical forces.

Prof. H. E. ARMSTRONG, F.R.S., in a characteristically incisive speech, strongly supported the chemical view of dissolution, and hence of occlusion of gases by molten metals. By way of illustration, he referred to an example put forward by Sir T. Kirke Rose in his speech, namely, the occlusion of oxygen in silver. In this case the higher the temperature the more oxygen was absorbed. As the temperature fell, however, the oxygen was not expelled until solidification, and then it all went off at once, and a shower of metallic globules was thrown out. Hydrogen occluded by molten copper behaved similarly. In Prof. Armstrong's view a definite oxide of silver was formed at a high temperature, when both elements must be regarded as being in different molecular forms from those obtaining normally, and having great affinity for one another. Similarly in the case of iron, carbonic oxide had a high affinity for it at some high temperature; hence the ease with which this gas passes through iron. This view, by the way, was ably controverted by Capt. L. AITCHISON.

Space will permit of a bare reference only to the many miscellaneous bearings of the subject of occlusion referred to by the various speakers. Thus Sir CHARLES PARSONS, F.R.S., regarded the formation of diamonds as being connected with occluded gases. Dr. H. A. BUMSTEAD, a distinguished visitor from America, spoke on the elimination of the last traces of absorbed gases in metals in a liquid air vacuum. Dr. R. S. WILLOWS similarly touched on the subject as it concerned X-ray apparatus, and indicated points where information was needed before the highest possible vacua could be obtained. Sir GEORGE BEILBY, F.R.S., illustrated an effect of occluded gases by reference to the dependence of the recrystallisation temperature of cold-worked gold on the presence of minute quantities of hydrogen. Mr. C. R. DARLING spoke of the effect of the absorption of gases on electric welding. The pickling of the iron rod used as negative in an acid produced a defective weld, in an alkali a sound weld. Dr. A. G. P. GWYER spoke on occlusion by aluminium and its alloys. Some blisters in cast metal which developed when it was rolled into sheet contained from one-tenth to one-third of their volume of occluded gas, principally hydrogen.

It was noteworthy that hydrogen was the chief gas occluded by the non-ferrous metals. The matter called for further study. In this connection Dr. J. A. HARKER, F.R.S., made the interesting observation that nearly all metals which absorbed oxygen gave at the moment of melting a large emission of gas, accompanied by a greatly increased electric emission.

The embrittling of iron by occluded gases raised the interesting question, what constituted brittleness. It was difficult to associate this quality with cobbler's wax, and yet to a sudden fracture this material would break like glass. The question of time was obviously involved, but Prof. Porter, who raised the question, confessed that it baffled him, as it baffled Prof. C. V. Boys, F.R.S.

Dr. Rosenhain's generalisation that all liquids were brittle, and cobbler's wax was a liquid, did not seem to give satisfaction, and Prof. Porter promised an explanation of his own at a later stage.

A considerable portion of the discussion was naturally taken up with the consideration of occlusion by the most important, technically speaking, of all metals, namely, iron and steel. The President, in his historical survey, drew attention to the interesting researches recently undertaken in Swarthouse, U.S.A., by Allemann and Darlington. These investigators, by means of a well-designed gas-tight vacuum furnace, capable of working at 1,900 deg. C., studied the gases occluded in ferrous alloys, and concluded that metals like aluminium, manganese, and silicon, which are commonly used to remove gas from steel, acted as catalytic agents in so doing. This theory was indirectly supported by a curious observation stated by Capt. L. AITCHISON to the effect that the addition of a very small amount of ammonia increased the rapidity of absorption of carbon monoxide in the case-hardening of steel. Dr. W. H. HATFIELD thought that the above-mentioned metals did not prevent the occlusion of gases, but caused them to be *retained* on freezing.

So far as iron and steel are concerned, Mr. COSMO JOHNS very much clarified an involved group of phenomena by distinguishing between "primary" or true occlusion, and "secondary" occlusion, where gases were formed as the products of reactions occurring during the cooling of the metal. The occlusion of hydrogen was an example of the former, and as it was more soluble in molten than in solid iron, the result of cooling was to concentrate the gas in the amorphous intercrystalline cement. This would explain why a comparatively small amount of gas had often a profound effect on the physical properties of the metal. The gaseous oxygen compounds, CO and CO_2, so often present in iron and steel, were probably actually formed *in situ* as the metal cooled.

Dr. THOMAS BAKER, who dealt quantitatively with the gases—hydrogen and carbon-monoxide—occluded in steel, did not follow Mr. Johns in his views, and considered the origin of these gases a problem still unsolved. A very carefully-thought-out paper by Dr. ANDREW MCCANCE discussed the reactions, with the gaseous products resulting therefrom, that took place in the melting furnace from the point of view of chemical dynamics. He concluded that blow-holes were formed in steel when there was a high CO_2 content, and this was dependent on the amount of FeO present. De-oxidants, such as silicon, removed the FeO, and at the same time converted CO_2 into the far more soluble CO, which was therefore merely taken up by the metal.

Perhaps the most important outcome of the discussion was the clear and general recognition of a negative truth: *We have no knowledge whatever of the true physical properties of pure metals*, for all experiments that have been made so far have been made on industrial metals which contain quite unknown quantities of gases. What a field for the happy investigator!

BUSINESS NOTES.

The "Electrical Review" Index.—As it is still necessary to effect every possible economy in paper consumption, the index to Vol. 83 of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

Tasmanian Carbon Factory.—The Hydro-Electric Power and Metallurgical Co. has set up a factory at Electrona, near Hobart, for the manufacture of carbon electrodes for its own use in the manufacture of carbides and also for general supply.—*Industrial Australian.*

Juvenile Employment after the War.—The Ministry of Reconstruction has issued (6d. net) a paper-covered book of 114 pages, in which the most important subject of "Juvenile Employment During the War and After" is very fully covered. The contents are really a long report, based upon reports by a large body of investigators who undertook an extensive inquiry for the Ministry of Labour during the closing months of last year and the beginning of this. All who are interested in the welfare of juvenile workers, whether independently or as industrial employers or managers, will no doubt feel it their duty to secure a copy of the book, and study its facts and conclusions carefully.

Export Restrictions Removed.—The *London Gazette* for December 20th contains a further list of export restrictions which have now been removed.

Calendar.—THE BRITISH EBONITE CO., LTD., Hanwell, W. 7, has issued a wall calendar for 1919, with monthly date sheets, each sheet having a complete year in miniature.

Trading with the Enemy.—Further names of bodies and persons in the following countries with whom trading is prohibited, appear in the *London Gazette* for December 20th:—Argentina, Bolivia, Cuba, Mexico, Spain.

Platinum Order Suspended.—The Minister of Munitions has suspended until further notice the Platinum Order, 1915, and the Platinum Metal Order, 1916, which prohibited purchases, sales, or dealings without a permit.

Engineering Trade Co-operation during Transition.—During the period of transition from the manufacture of war material to ordinary trade, some difficulty may be experienced by firms having more orders on their books than they can readily deal with, whilst there will be other firms having manufacturing facilities without orders to execute. It is considered essential in the national interests that firms in these two categories should be brought into intimate touch as rapidly as possible. With this object in view, manufacturers in the engineering and allied trades who need the assistance of sub-contractors, and who meet with difficulty in finding suitable firms to undertake their sub-contracts, are requested to communicate with the Superintendent Engineer of the Ministry of Munitions in the area concerned. Similarly, manufacturers having capacity available with the necessary labour should notify the Superintendent Engineer of their area. The Superintendent Engineers will give every possible assistance to manufacturers in overcoming difficulties which may arise during the transition from war to peace manufacture. A list of the Superintendent Engineers, and addresses of the area offices, is appended :—

DEPARTMENT OF ENGINEERING.

LIST OF SUPERINTENDENT ENGINEERS.

Area No.	Name.	Address.	Telegraphic address.	Telephone No.
1	Mr. G. H. Clay.	Pearl Buildings, Northumberland Street, Newcastle-on-Tyne.	Munarea, Newcastle.	3814 Central.
2	Mr. H. C. Buckmaster.	70, Spring Gardens, Manchester.	Munarea, Manchester.	8740/8 City.
3	Mr. H. C. M. Austen.	Quebec Chambers, Quebec St., Leeds.	Munarea, Leeds.	5300 Leeds.
4	Mr. A. A. Rowse.	111, New Street, Birmingham.	Munarea, Birmingham.	2700 Midland.
4 E	Mr. G. S. Knocker.	91, Queen's Walk, Nottingham.	Munarea, Nottingham.	5578/9 Nottingham.
5 & 6	Mr. Selwyn Grant.	3, Unity St., College Green, Bristol.	Munarea, Bristol.	4060 Bristol.
7	Lieut. Moberly.	Room 114, Charing Cross B'ldgs., Embankment, W.C. 2.	Mundepeng, Phone London.	Gerrard 540, Ext. 712.
8	Mr. G. Davidson.	90, Princes Street, Edinburgh.	Munarea, Edinburgh.	9040 Central.
9	Mr. W. D. Kirkwood.	39, Elmbank Crescent, Glasgow.	Munitions, Glasgow.	9980 Central.
10	Capt. C. Ablett.	32, Nassau Street, Dublin.	Munarea, Dublin.	4894/6 Dublin.
11	Mr. A. W. Brown.	Coates Buildings, Castle St., Belfast.	Munarea, Belfast.	57 8 Belfast.

The Fraser & Chalmers Sale.—In the course of his speech at the annual meeting of MESSRS. FRASER & CHALMERS, LTD., last week, Mr. A. W. Tait said that for some time the directors had appreciated that, in order to secure the full development of their manufacturing business, particularly in connection with turbines and turbo-blowers, they should seek an alliance with some company or group in the electrical industry which would be sufficiently strong to quote for and obtain contracts and orders for large electrical installations both at home and abroad. The arrangement with the General Electric Co., Ltd., of which particulars have been given in these pages, followed in due course. Mr. Tait later referred to the steps taken in disposing of the purely merchanting business in South Africa, where Mr. Haig, the manager, and others, had purchased the business, and in Canada, where Mr. Sancton (the manager) had taken over the assets. Negotiations were also proceeding with the General Electric Co., Ltd., with regard to the business in Australia and in Singapore, and it was hoped that before long these negotiations would be satisfactorily concluded. The speaker suggested the voluntary liquidation of the company, and this idea received the meeting's approval.

British Magnetos.—As a proof of the great strides the British manufacturers are making in the production of magnetos, we are informed that Messrs. C. A. Vandervell & Co.'s output for October alone was no less than 3,500. The C.A.V. magneto figured largely on the motor cycles of our dispatch riders on all fronts during the war, and we understand that it met with their highest commendation.

New Trust for Development of Electrical Undertakings.—Following upon our recent reference to the Aabada Trust, Ltd., we observe in the daily papers that this concern has been holding a general meeting in London, under the chairmanship of the Earl of Kintore. He said that the trust had been in existence since 1912, though for the past few years its operations had been restricted by the war. Its current business was almost entirely confined to the development of electrical undertakings and to allied interests. The managing director, Mr. C. S. Colton, and the engineers had long been associated with the electrical industry. Mr. J. W. Towle, M.I.E.E., who was formerly superintendent of power for the Metropolitan District Railway and for the London Electric Railways and chief engineer to the Ebro Irrigation Power Co., Barcelona, had been appointed chief of the trust's engineering staff. The trust would, therefore, have at its disposal the highest technical knowledge, both for the selection of its undertakings and for the supervision of its execution. The financial resources of the trust were sufficient for all the requirements of the current business, and should further working capital be required for extensions the trust had an unissued capital of £44,000. It had large and important business on hand, and in regard to some of its undertakings, several of the best-known engineering and chemical firms in the country were jointly interested with it.

After-war Trade.—We have received a copy of the fourth report of the London Chamber of Commerce Special Committee on Trade During and After the War, which was adopted on December 12th. This report completes the series issued by the Committee, and indicates the changed situation and altered possibilities as well as new economic problems which have arisen since the issue of the first three reports, with special reference to (*a*) matters of common interest to the business community as a whole; (*b*) commercial organisation; (*c*) industrial organisation; (*d*) finance.

Holidays.—The London office and works of MESSRS. JAMES KEITH & BLACKMAN CO., LTD., are closed as from last Saturday until Monday next, while the works at Arbroath, N.B., are closing from Saturday next until January 6th, for the Christmas and New Year holidays and to mark the cessation of hostilities.

Fiat Cars in the War.—With the Armistice, not a little information to which the Censor formerly objected now becomes available for publication. While the war was in progress, for instance, it was forbidden to give the actual output of the motor-car factories supplying material to the Armies. This restriction having been removed, the Fiat Co. has made a statement of the actual number of cars and lorries it has supplied for Army use. In 1914, Italy then being neutral, not more than 500 motor vehicles were supplied for Army use. Between January 1st, 1915, and October 30th, 1918, the number of cars and lorries built for the Allied Armies totalled 50,000. Of this number 30,000 went to the Italian Army, 15,000 to the French Army, and 5,000 were divided among the American, British, and Portuguese Armies. The record monthly output was 2,023 during October, 1917, this being an average of 75 motor vehicles per working day. This daily record was considerably exceeded later when, the Italian Government having requested the factories to speed up to their utmost limits, in order to make good the material lost in the Caporetto disaster, the Fiat factory succeeded in attaining the wonderful record of 176 motor vehicles (the majority of these were lorries) produced during the working hours of December 31st, 1917. It is believed that this is the largest number of vehicles produced by any European factory in one day. It has to be taken into consideration, too, that the Fiat cars and lorries are produced entirely in the company's works, only the tires being procured from outside. This record output was attained without interfering with the normal production of aeroplanes and aeroplane engines.

Our Letters from the Forces.—A correspondent in France writes :—"Please accept my very best thanks for your continued kindness in sending the REVIEW so regularly. It has been a source of entertainment and profit to me out here, and during the whole time you have been sending (nearly two years) it has never failed to turn up. I sincerely hope that in a very few months we shall be back to our jobs again, and able to follow the REVIEW every Friday in more congenial surroundings. I shall never forget, however, how much I, and numerous friends here, owe to you for your weekly REVIEW in France."

Loans to Local Bodies.—The Local Government Board is now prepared, in conjunction with the Treasury, to consider applications from local authorities for permission to raise loans in order to enable them to put into operation schemes of public utility, such as housing, water supply, gas and electricity, and construction and improvement of roads, which are of urgent importance. It is essential that the necessary loans should be raised locally by the authorities concerned, except in the case of the smaller authorities who, requiring money for very urgent services, may be able to secure advances from the Local Loans Fund.

Catalogues and Lists.—MESSRS. SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—Publicity card giving price, &c., of one of their weather-proof reflector fittings.

AUTOMATIC AND ELECTRIC FURNACES, LTD., 6, Old Queen Street, London, S.W. 1.—Bulletin No. 6, relating to the use of molten salt baths in hardening operations.

THE COUNTY OF LONDON ELECTRIC SUPPLY CO., LTD., has issued a telephone card, the pictorial feature of which shows Armistice celebration beneath the electric lights of Home.

Training Disabled Soldiers.—In connection with the scheme for the restoration of disabled service men to industrial life, large training centres have been established in various East Lancashire towns, those for electrical engineering being formed at Bootle, and for motor mechanics at Bolton.

Changing Over at Vickers's.—According to a note in the *Times*, 30,000 munition workers employed at Vickers's stopped work on Saturday until January, the suspension being arranged to enable the firm to take stock and to prepare for peace industries.

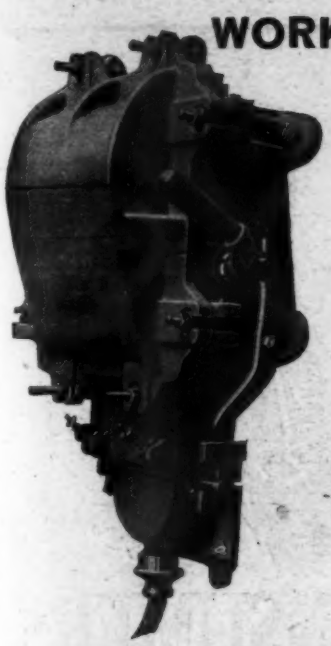
Building Work May Now Proceed.—The National Service Ministry has cancelled the Order of February last which prohibited the beginning or proceeding with building or construction works exceeding £500 in value, without licence.

The 47-hour Week.—Though the total figures are not yet known, the returns of several fairly large Unions not having been received, it is stated that the result of the engineers' ballot on the acceptance or rejection of a 47-hour week without any reduction of wages is strongly in favour of the proposal.

VERITYS LTD

ENGINEERS,

WORKS: ASTON, BIRMINGHAM.



'ASTON' FLAMEPROOF SWITCH,

WITH TWO-PIN INTERLOCKED PLUG.

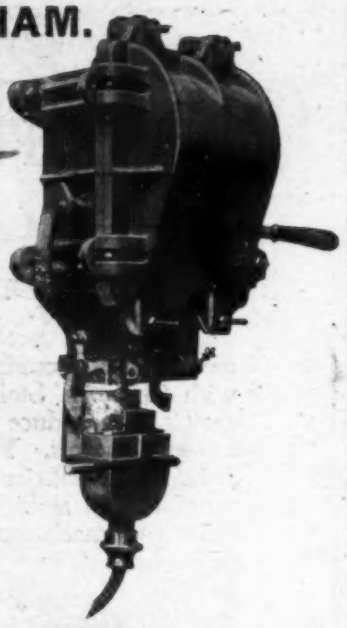
Designed for Aerodromes, Chemical Works, Shell-filling Factories and Fiery Mines.

1½" machined facings between box and lid.

Plug Contacts are in separate Chamber.

The Plug cannot be inserted the wrong way or withdrawn while current is on.

Substantially made to withstand rough usage.



LONDON: 31, King Street, Covent Garden, W.C. 2

BIRMINGHAM: Phœnix Chambers, Colmore Row.

BRISTOL: 59, Victoria Street.

MANCHESTER: Hardman Street, Deansgate.

NEWCASTLE-ON-TYNE: Edinburgh Life Assurance Buildings, 21, Mosley Street.

GLASGOW: 51, Waterloo Street.

LIVERPOOL: 518, Royal Liver Buildings.

A 117.

TUCKER SWITCHES.

OUR TWENTY YEARS' REPUTATION IS OUR CUSTOMERS' UNFAILING GUARANTEE . . . . . .

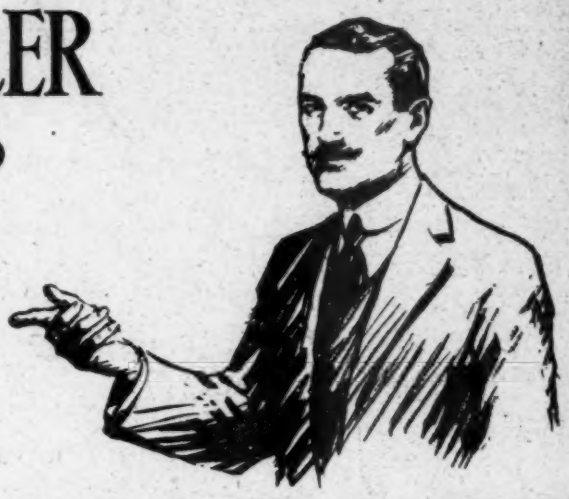
J. H. TUCKER & Co.,

SWITCHES . . . . ACCESSORIES . . . . IRONCLAD GEAR
SWITCHGEAR . . . . . .

King's Road, Hay Mills,

BIRMINGHAM.

THE COAL CONTROLLER DECLARES



THAT economy in coal is still necessary. Don't wait for him to put your boiler-house in order. Have your boilers fitted at once with "Bennis" Stokers, and see how easy it is to produce steam from cheap low-grade fuels. Your plant will be at its highest efficiency if you combine a mechanical stoking equipment with "Bennis" machines for handling coal and ashes.

COAL CONSUMERS MUST BURN

Pit rubbish and other waste fuels. Ask us to show you recent tests taken with "Bennis" machine stokers. We shall be pleased to do so, or to give references to numerous up-to-date works where "Bennis" stokers are raising all the steam required from

SLACK AND COKE BREEZE

Write to-day for particulars.
It will be worth your while.

Ed. Bennis & Co., Ltd.
LITTLE HULTON, BOLTON
and 28 Victoria Street, London, S.W.1.

Ward & Goldstone
SALFORD MANCHESTER

INQUIRIES FOR HOME & EXPORT RECEIVE PROMPT ATTENTION

CABLES

FOR ELECTRIC LIGHTING, POWER, TELEPHONE, SHOT-FIRING AND ALL ELECTRICAL PURPOSES.

FLEXIBLES

OF EVERY DESCRIPTION FOR LIGHTING, POWER, TELEPHONES, WIRELESS, AEROPLANES, AUTOMOBILES, SUBMARINES, BELLS & MEDICAL APPARATUS.

WIRES

COTTON AND SILK COVERED, ENAMELLED, "PERKA", BELL WIRES FUSE WIRES &c.

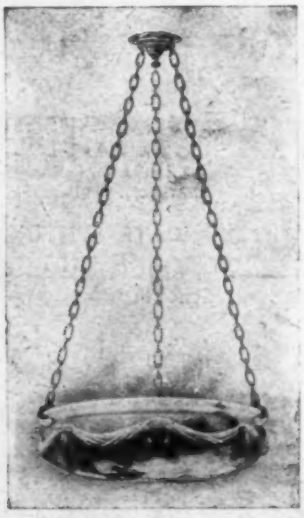
SECTIONAL CATALOGUES ON REQUEST.

INSULATING TAPES

"ACME" BLACK ADHESIVE, PURE RUBBER, "MAGOHM", COTTON, SILK AND FELT.

N-K SPELLS O-K

ALABASTER BOWL FITTINGS



BIG STOCKS

Send us your Enquiries *for Everything Electrical.*

BRADFORD SHOWROOMS:
St. George's Hall.

NAPIER-KIMBER, LTD.,
109, GT. PORTLAND STREET,
LONDON, W. 1.
Telegrams: "APIERIMBER 'PHONE. LONDON."
Telephone: MAYFAIR 3860.

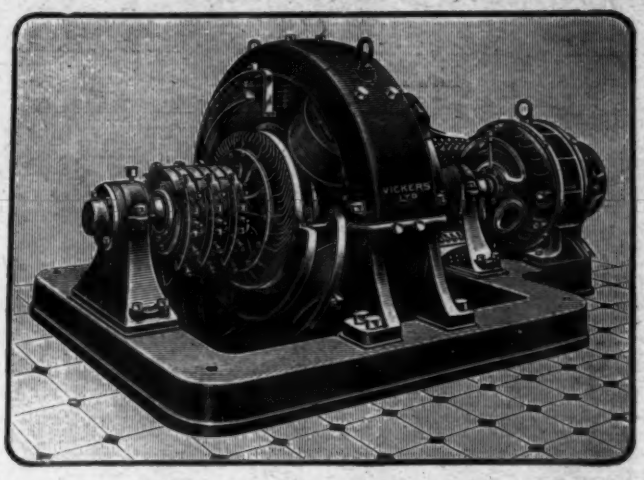
GLASGOW:
200, St. Vincent St.

VICKERS LIMITED

Electrical Plant of every description.

Rotary Converters.

Turbo Alternators.



Motor Generators.

Motors of all types.

350-KW. ROTARY CONVERTER, 750 R.P.M., 480/460 VOLTS.

Head Offices:
VICKERS HOUSE, BROADWAY,
WESTMINSTER, S.W. 1.

Works:
RIVER DON WORKS
SHEFFIELD.

WANDSWORTH

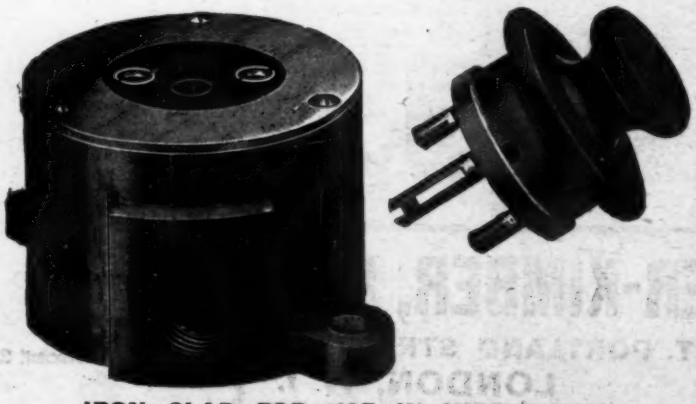
London Offices and Stores:
165, WARDOUR STREET, W.
Telegrams: "Wemcolim, London."

Head Office and Works:
LUDGATE HILL, BIRMINGHAM.
"Current, Birmingham."

THE WANDSWORTH SWITCHPLUG IS FOOLPROOF

(PATENT).

IT IS SELF-CONTAINED. NO SEPARATE SWITCH IS REQUIRED. IT IS AUTOMATIC IN ACTION, THE RAPID MAKE AND BREAK SWITCH MECHANISM BEING OPERATED BY THE INSERTION OR WITHDRAWAL OF THE PLUG.



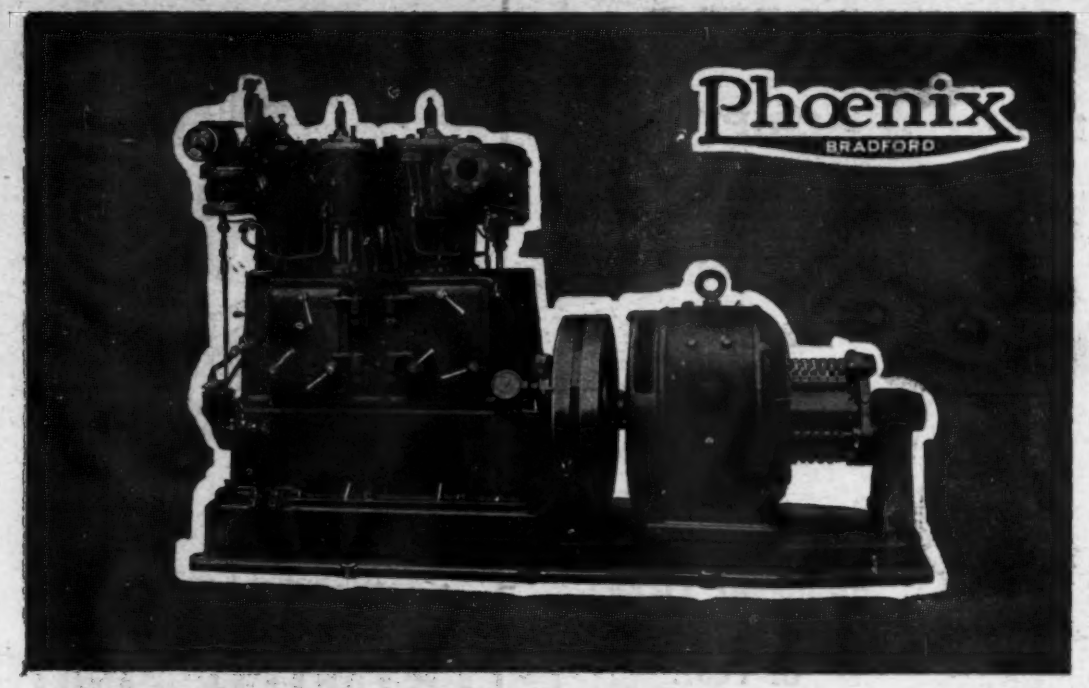
IRON CLAD FOR USE IN WORKSHOPS.

MADE IN 5 & 15 AMP. SIZES.

GAS TIGHT.

WATER TIGHT.

IRONCLAD
OR
HARD WOOD COVERS.



Note the worthy features of Phoenix Ship Lighting Dynamos.

1. Minimum weight per kilowatt output is obtained by the use of steel carcase and steel fittings where possible and the correct distribution of all active copper and iron.
2. Mica insulation and special impregnation rendering windings impervious to moisture.
3. Perfect balance and absence of all magnetic hum.
4. All parts made to jig and interchangeable. Spare parts of standard sizes stocked.

Phoenix Dynamo Manufacturing Co., Ltd., Bradford.

Phoenix
BRADFORD

Telegrams: "DYNAMO, BRADFORD." Tel. Nos. 3700, (8 lines), Private Branch Exchange.

QUALITY FIRST ASK PHŒNIX TO QUOTE

QUALITY FIRST ASK PHŒNIX TO QUOTE

WORKING IN CONJUNCTION WITH DICK KERR & Co Ltd SIEMENS BROS & Co Ltd

DICK-KERR | PHOENIX | SIEMENS

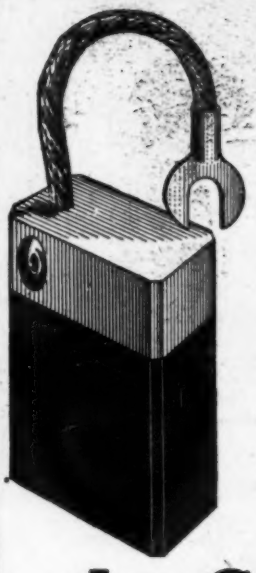
BRUSHES

OF

EVERY DESCRIPTION

FOR

DYNAMOS AND MOTORS.



LARGE STOCKS IN LONDON.

□ □ □

DELIVERY OF STANDARD TYPES BY RETURN OF POST.

□ □ □

Le Carbone,

Coventry House, South Place, London, E.C.2

Tel. No.: London Wall 6587.

CRYSELCO

METAL FILAMENT LAMP

Manufactured only by the All-British Lamp Company,

CRYSELCO, LIMITED,

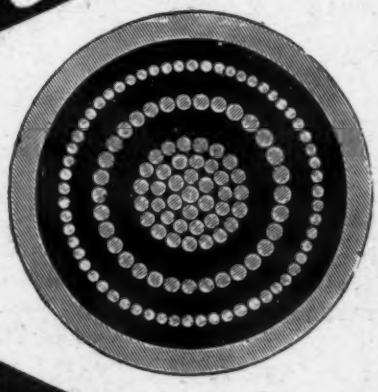
Kempston Works,

BEDFORD.

Telegrams: "Cryselco, Kempston." Telephone: 117 Bedford

"LIVERPOOL"

ELECTRIC WIRES & CABLES



LONDON:
BAXTER & GAUNTER, Ltd.,
219, Tottenham Court Road, W.

MANCHESTER:
H. G. MABBS,
Marble St., Spring Gardens.

LEEDS:
LOXLEY & CO., Ltd.,
20, Basinghall Street.

NEWCASTLE-ON-TYNE:
ROBERT BOWRAN & CO., Ltd.,
St. Nicholas Buildings.

GLASGOW:
A. & J. M'CULLOCH,
140, West George Street.

IRELAND:
F. A. PORTER,
13, Queen's Square, Belfast.

LIVERPOOL ELECTRIC CABLE CO., LTD.,

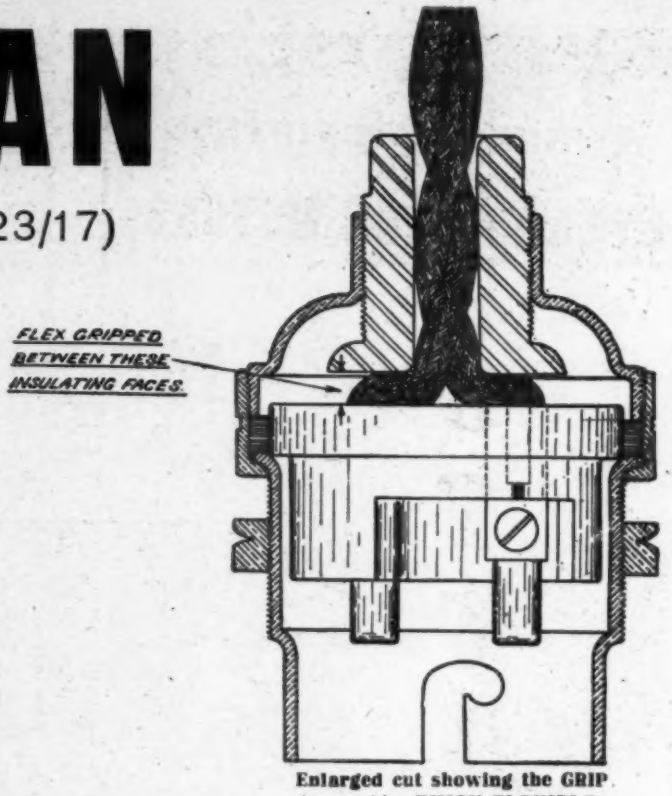
Head Office & Works: LINACRE LANE, BOOTLE, LIVERPOOL.

Telephone No. 542 Bootle. Telegrams: "Concentric, Liverpool."

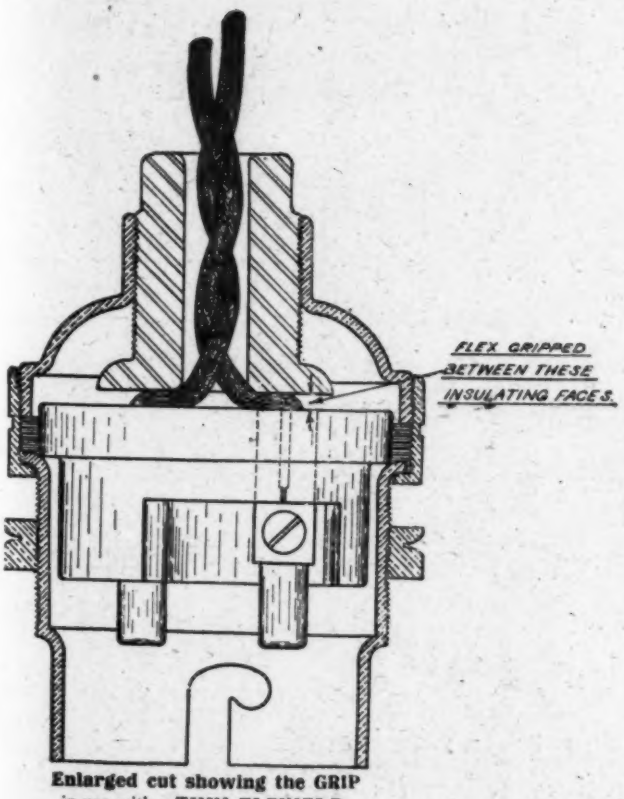
EDISWAN

(Lamlok Patent 10423/17)

NEW CORD GRIP



Enlarged cut showing the GRIP in use with a THICK FLEXIBLE.



Enlarged cut showing the GRIP in use with a THIN FLEXIBLE.

SPECIAL FEATURES.—This Grip has been designed for converting Standard ½-in. or ⅝-in. Female Thread Holders (with or without Shade Carrier Rings) into Efficient Cord Grip Holders.

It will be seen from the drawings that the Flexible (either thick or thin variety) is efficiently and harmlessly gripped between two insulating surfaces, the Holder Porcelain and the interior of the Insulating Material Grip itself (the latter being adjustable to suit varying thicknesses of flexible) and held as in a vice without, however, any chance of injury at the time of installation or later to the insulation of the conductor.

The hole through the grip being large, the flexible is "free" at the outlet, so that breaking at this point is entirely obviated and short circuits thus avoided—a constant source of trouble with the standard Brass-and-Wood-Grip.

Time and annoyance is saved in wiring, in that the paring of the grips (a tedious and lengthy process making for inefficiency) is entirely avoided

Send for Leaflet A3195 and special terms for resale to—

THE EDISON SWAN ELECTRIC CO., LTD.,

PONDERS END, MIDDLESEX.

Depots and Branches:

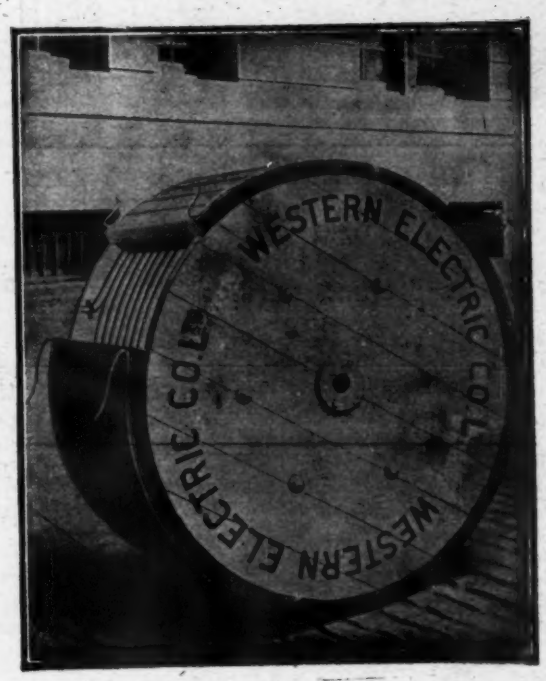
123/5, QUEEN VICTORIA ST., E.C. 4
BELFAST.
BIRMINGHAM.
BRISTOL.
CARDIFF.
CORK.
DUBLIN.
DUNDEE.
GLASGOW.

ENGLISH EDISWAN EVERYTHING ELECTRICAL

71, VICTORIA ST., S.W. 1
HULL.
LEEDS.
LIVERPOOL.
MANCHESTER.
NEWCASTLE.
NOTTINGHAM.
SOUTHAMPTON.
SWANSEA.

Western-Electric

On Every Highway and By-way



these drums of

WESTERN ELECTRIC CABLE

bear silent witness to the universal satisfaction resulting from its use.

Best for overhead lines and indispensable for underground construction.

Western Electric Company Limited

Branch Offices and Stores:

BIRMINGHAM, GLASGOW, LEEDS,
SYDNEY, JOHANNESBURG, BUENOS AIRES.

Agents for India: Jost's Engineering Co., Ltd., Bombay.

THE CONSOLIDATED PNEUMATIC TOOL CO., LTD.,

THE LARGEST MANUFACTURERS OF

PORTABLE ELECTRIC TOOLS

FOR ALL PURPOSES.

"LITTLE GIANT" HEAVY DUTY AIR-COOLED ELECTRIC DRILLS & GRINDERS

FOR

PORTABLE DRILLING, REAMING, TUBE EXPANDING AND GRINDING.

Wound for all Currents and Voltages.

Designed to withstand the heavy overloads incidental to hard and continuous work without damage.

Size No. 3X. Supplied either in Side or, Centre Spindle Type.

Capacity: STEEL, 1" WOOD, 2"

PORTABLE ELECTRIC DRILLS,

made in various sizes, capacities $^{5}/_{16}$" to 2" in metal.

Machines for Engineers, Shipbuilders, Iron Founders, Motor Car Builders, Motor Garages, Aeroplane Builders.

PORTABLE ELECTRIC BLOWER,

DIRECT AND ALTERNATING CURRENT.

For cleaning the windings of Electrical Machinery and Switchgear.

Write for Catalogue No. 9 E.

General Offices:
EGYPTIAN HOUSE, 170, PICCADILLY, LONDON, W. 1.
Teleg. Add.: "Caulking," Phone, London.
Telep. No.: Gerrard 9215 (3 lines).
Main Works: FRASERBURGH, SCOTLAND.

London Showroom and Repair Works:
73, 75, 79 & 80, YORK STREET, S.W., 1
near St. James's Park Station (Dist. Rly.).

The Lusty Lung, with all his might
The praise is sung to friend Fluxite.

Electricians, Plumbers, Gasfitters and other Metal Workers, all sing the Praises of

FLUXITE

as the paste flux that solders even dirty metals without cleaning or corrosion, and joints lead without solder merely by the use of a blow-lamp or blow-pipe. In short, Fluxite

SIMPLIFIES SOLDERING

and Supersedes Lead-Burning.

If desired some solder can be filed into a little Fluxite and the two applied together. Fluxite is a necessity in every tool-kit.

YOU WANT SOME.

Of Ironmongers and Oilshops. In Tins, 8d., 1/6 and 2/3.
Made by THE AUTO-CONTROLLER CO., 84, Vienna Road, Bermondsey, S.E.

BON-ACCORD

CENTRIFUGAL PUMPS

For Coal Washing, Circulating, &c.

Try "Bon-Accord" PACKING

For the Stuffing Boxes of your Pumps and Engines.

TURBINE PUMPS for Mine Pumping and Sinking.

HIGH-SPEED ENGINES

For Dynamos, Fans, Pumps, &c.

DRYSDALE & CO., LTD., YOKER, GLASGOW, W

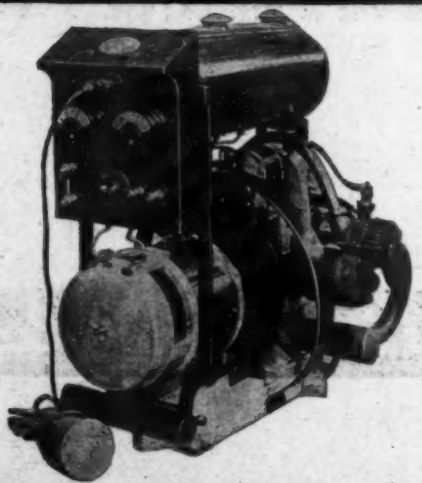
ARTHUR LYON & WRENCH

LIMITED

PORTABLE

MOTORS
DYNAMOS
GENERATING SETS

SIZES UP TO 10 H P



Extract from France:

"I had one of these engines running for 68 hours without stopping once and giving us 26 amperes 65 volts without a single flicker."

London Office
36, VICTORIA STREET, S.W. 1.
Phone: Victoria 2543. Telegrams: "Centranos, Vic."

Works:
WILLESDEN, N.W. 10.

Secures the utmost economy in Users' Electric Lighting consistent with Brilliancy, Strength and Long Life.

Cosmos Lamps are made in England at the Cosmos Lamp Works, Brimsdown, Middlesex.—Licensed under British Patents.

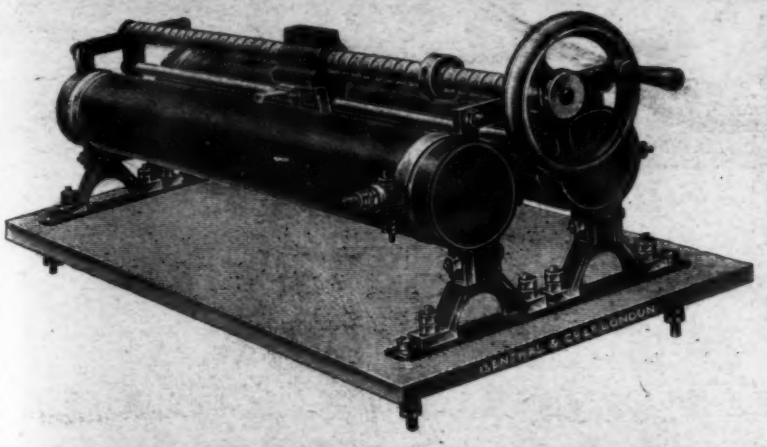
Proprietors:

The British Westinghouse Electric & Mfg. Co., Ltd.
14, Long Millgate, Manchester.

Stores & Sales Depots: 179, Wardour Street, LONDON, W. 143, St. Vincent St., GLASGOW. 55, Newhall Street, BIRMINGHAM. 4, Albion Street, Boar Lane, LEEDS. 9, Millicent Street, CARDIFF. Chapel Walk, Fargate, SHEFFIELD. 8, Ward's Bldgs, High Bridge, NEWCASTLE-ON-TYNE. CALCUTTA. BOMBAY. JOHANNESBURG. MELBOURNE.

Electricians and Dealers should write for Price Lists and Showcards.

"See things in a better light"



RHEOSTATS.

Sliding Contact Types

ISENTHAL & CO., LTD.

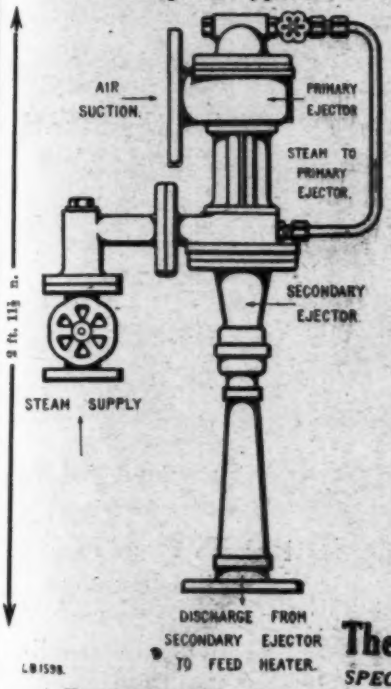
(Department 3),

DENZIL WORKS, WILLESDEN, LONDON, N.W. 10.

Contractors to the Admiralty, War Office, India Office, Colonial Office, Postmaster-General, &c.

The Mirrlees-Leblanc Steam Multijector Air Pump.

"Simple" Type.



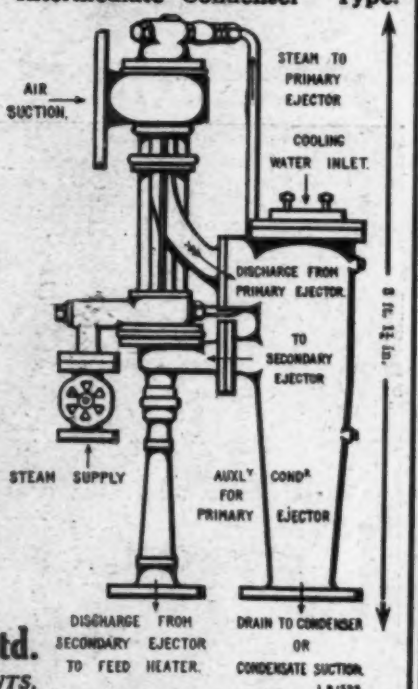
For 5000 KW. Plant.
Weight 97 lbs.
Operating Steam 880 lbs. per hour

THE MIRRLEES WATSON

Write us for advice as to which type is most suitable for *your* conditions.

The Mirrlees Watson Co., Ltd.
SPECIALISTS IN CONDENSING PLANTS,
Glasgow.

"Intermediate Condenser" Type.



For 5000 KW. Plant.
Weight 200 lbs.
Operating Steam 400 lbs. per hour.

We are now MANUFACTURING

"EMPIRE" OILED INSULATING CLOTHS AND TAPES IN ALL THICKNESSES.

IMMEDIATE DELIVERY. ***PRICES UPON APPLICATION.***

"EMPIRE" SILKS & PAPERS ALSO NOW IN STOCK.

MICANITE & INSULATORS CO., Ltd.,
Empire Works, WALTHAMSTOW, E. 17.

Telegrams: "Mytilite 'Phone, London." Telephone: 738 & 739 Walthamstow.

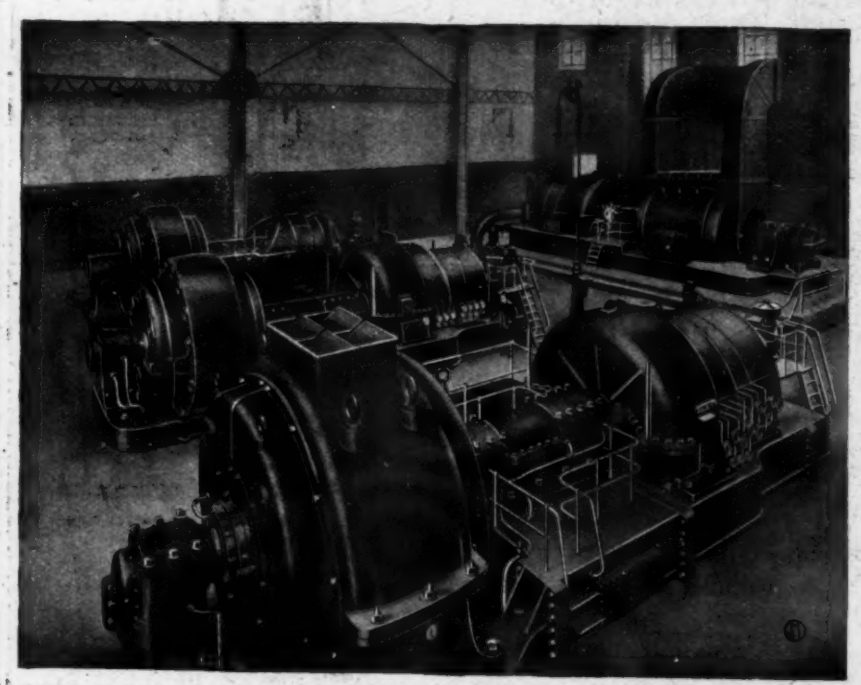
PORCELAINS

for

SPARKING PLUGS;
Electric Heating and Cooking;
Lighting, Power Transmission, Telegraph, Telephone and Wireless Installations.

James Macintyre & Co., Ltd.
BURSLEM.

JAMES HOWDEN & Co., Ld.,
GLASGOW.



MANCHESTER CORPORATION ELECTRICITY WORKS. TOTAL KILOWATTS, 37,500.

"IMPULSE" STEAM TURBINES
of High, Low and Mixed Pressure, and Pass Out Types,
300 to 25,000 kwts.

HIGH-SPEED STEAM ENGINES,
5 to 2,500 B.H.P.

Patentees and Manufacturers of:—
Howden's Forced Draught
Wallsend-Howden Oil Burning System.
Fans for Suction Draught, Ventilating, &c.
Patent Combination Water-Tube Boilers.

SHAW
HIGH PRESSURE STEAM
VALVES AND
BOILER MOUNTINGS.
TRY "N.K.L." METAL FOR SUPERHEATED STEAM.
J. SHAW, SON & GREENHALGH, LTD., Albert Works, HUDDERSFIELD.

For Watchmen, Meter Reading, Breakdowns, &c.

BRITISH UTILITIES, LTD.,

despatch weekly to power stations and works throughout the Kingdom, their high-class

"BUL" DRY BATTERIES

for Portable Torch and Hand Inspection Lamps.

PRICES ON APPLICATION.

ADDRESS:—

BRITISH UTILITIES, LTD.,

Wandle Bank, Wimbledon, S.W. 19.

Dry Battery Makers to the Admiralty, W.D. and R.A.F.

Telegrams: "SHINALITE, LONDON." Telephone: 787 WIMBLEDON.

W. MACKIE & CO.,

ELECTRICAL AND MECHANICAL ENGINEERS,
PALACE ENGINEERING WORKS,
129, 131, 133, LAMBETH ROAD, S.E. 1
Telephone: Hop 182.

DYNAMOS AND MOTORS.
REPAIRS OF EVERY DESCRIPTION.
MANUFACTURERS OF WIRELESS COMPONENTS.

GEORGE ELLISON

Mechanical & Electrical Engineers
Makers of Electrical Control Gear

BIRMINGHAM, LONDON, MANCHESTER, GLASGOW, NEWCASTLE, LEEDS, CARDIFF, MOSCOW, MILAN, JOHANNESBURG, SYDNEY, N.S.W., COPENHAGEN, CHRISTCHURCH, N.Z.

INDUSTRIAL
ELECTRIC SWITCH
and
CONTROL GEAR.

Star Delta Starter Panel.

WE specialise in the production of Switch and Control Gear for Industrial Purposes. Ellison Gear has given satisfactory service in the Engineering, Textile, Colliery and other Industries. Its design complies with Home Office requirements and the demands of modern practice.

Head Office and Works:
PERRY BARR, BIRMINGHAM.

ELECTRIC CONTROL GEAR

WILSON HARTNELL & CO., LTD., VOLT WORKS, LEEDS.

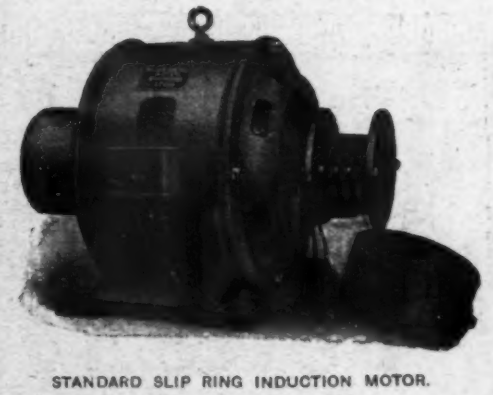
"HARTNELL"

POLYPHASE MOTORS

RUN ON **BALL BEARINGS.**

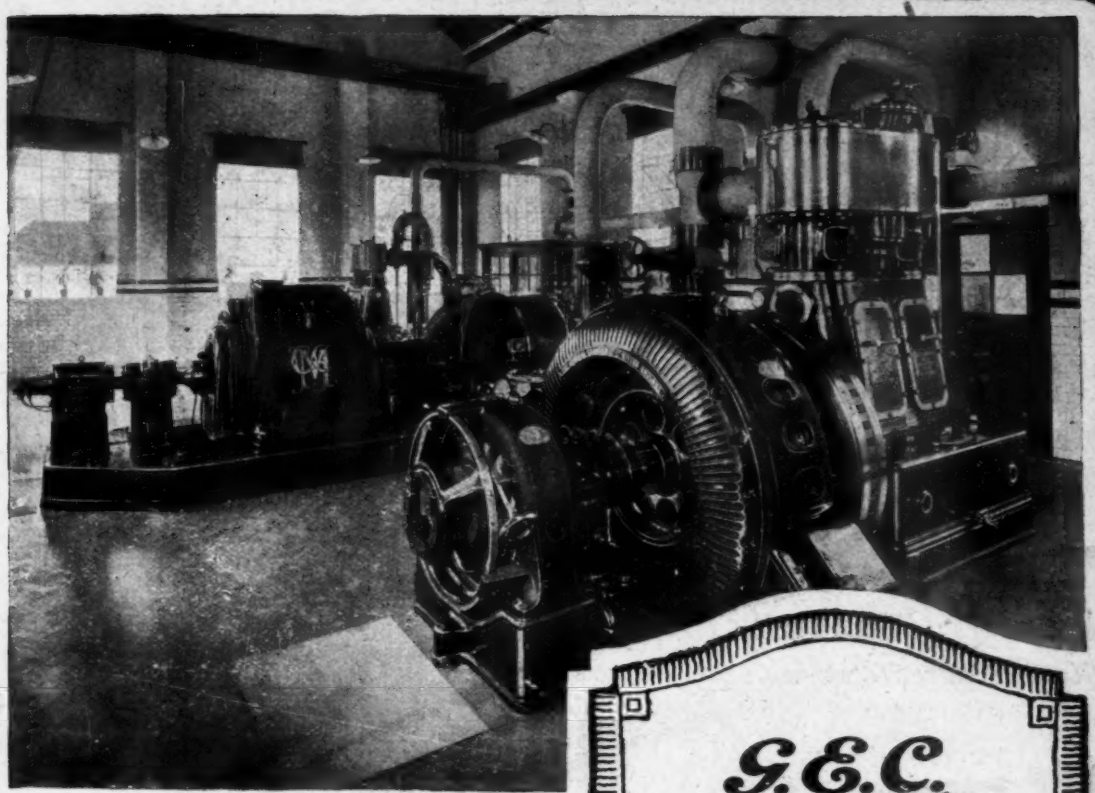
Smooth Running and Low Running Costs Assured.

DIRECT-CURRENT MOTORS
AND DYNAMOS,
SWITCHBOARDS, &c.



STANDARD SLIP RING INDUCTION MOTOR.

London Office: 38, Victoria Street, Westminster, S.W. 1.



A typical "Witton" Power Plant for utilising the energy from exhaust steam in a colliery.

G.E.C.

"Witton"

ELECTRICAL PLANT

REG? TRADE MARK

The GENERAL ELECTRIC COMPANY, Ltd.,

Head Office: Queen Victoria Street, LONDON.

Telephones: London Wall 3600 (32 lines). Telegrams: "Electricity Cent. London."

BRANCHES:

Manchester—Victoria Bridge.
Liverpool—Electricity Building, Church Alley.
Leeds—11a, Wellington Street.
Sheffield—Angel Street.
Glasgow—71, Waterloo Street.
Cardiff—Womanby Street.
Bristol—81, Victoria Street.
Swansea—44, Wind Street.
Ipswich—Princes Street.
Newcastle-on-Tyne—30, Gallowgate.
Hull 64 & 65, Charlotte St.
Southampton—24, High St.
Aberdeen—26, Bridge Street.
Birmingham—42, High St.
Nottingham 4, Chapel Bar.
Belfast—13, Queen Street.
Dublin—13, Trinity Street.
Cork—76, Grand Parade.

Works: Witton, Manchester, Birmingham Erith and London.

THE "ELECTRICAL REVIEW"

CHEAP PREPAID ADVERTISEMENTS

Relating to Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of ONE PENNY per Word (minimum 1s.). Box Number and "Electrical Review" Address count as Seven Words.

LATEST TIME FOR RECEIVING 9.30 a.m. THURSDAYS.

Where Advertisements are to be answered to a given Number at the "Electrical Review" Office, applications for Names and Addresses of the Advertisers will be entirely disregarded, and Letters giving incorrect Box Numbers will be destroyed.

*** The Scale does not apply to Trade Advertisements, terms for which can be had on application to 4, Ludgate Hill, London, E.C. 4.

OFFICIAL NOTICES, &c., 1s. per line in Column.

The ELECTRICAL REVIEW is the recognised medium of the Electrical Trades, and has by far the LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

Unless otherwise instructed, **ALL LETTERS** received in answer to Advertisements with a Box number, **ARE FORWARDED NIGHTLY.** Postages incurred are charged at cost.

ELECTRICAL

PARTNERS and PARTNERSHIPS

can be obtained through

WHEATLEY KIRK, PRICE & CO.

(Established 1850).

46, Watling Street, London, E.C.

13, Albert Square, Manchester.

26, Collingwood Street, Newcastle-on-Tyne.

SITUATIONS VACANT.

Latest time for receiving 9.30 a.m. Thursday.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

WORKING ELECTRICIAN.

WORKING ELECTRICIAN wanted to take charge (except driving) of a 125-kilowatt station with power plant driven by same and which will probably be extended soon. Trained experienced electrician and mechanic required who must have good knowledge and experience in the repair and maintenance of electric motors and must be a capable winder of dynamo and motor armatures and coils. He must also have a good practical knowledge and experience of gas engines, as he will be responsible for the upkeep of these on the station.

Apply, stating age, wages required, and enclosing copies of three recent testimonials.

Required to take up duties immediately.

3345, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

ASSISTANT INSTRUCTORS.

Ministry of Pensions Training Schemes for Disabled Men.

WANTED IMMEDIATELY, qualified Assistant Instructors for part time only in electrical engineering (laboratory practice), and also in installation, maintenance and repair work (practical).

Knowledge of A.C. and D.C. machines and of up-to-date installation practice is essential.

Apply, giving particulars of qualification and experience, to Mr. F. H. TAYLOR, Central Polytechnic, Scarbrook Road, Croydon. 3688

SITUATIONS VACANT.—*Continued.*

COUNTY BOROUGH OF WOLVERHAMPTON.

Electrical Engineer's Department.

APPLICATIONS are invited for the position of Distribution Superintendent in the above department.

Candidates must have received a thorough technical training and had experience in the construction, control and maintenance of extra high tension and low tension mains and networks, rotary and static sub-stations, the installation of wiring, and industrial machinery, and the maintenance and repair of motors and other apparatus.

It is necessary for applicants to have proved abilities in the organisation of an outside department, and the efficient control of men.

Applicants must not be less than twenty-five years of age.

Salary £300 per annum.

Applications made on the form, which, with list of duties, may be obtained from the undersigned, to be delivered in envelope, endorsed "Distribution Superintendent," addressed to the CHAIRMAN OF THE ELECTRICITY COMMITTEE, c/o Town Clerk, Town Hall, Wolverhampton, on or before the 10th JANUARY, 1919.

S. T. ALLEN,
Chief Engineer and General Manager. 3670

MINISTRY OF PENSIONS.

Joint (Disablement) Committee for North Wales.

BANGOR TRAINING CENTRE FOR DISABLED SAILORS & SOLDIERS.

WANTED, INSTRUCTOR in Electrical Work, including wiring and other practical work, together with a sound knowledge of the elementary theory of electrical engineering. Must be able to give lectures and demonstrations in wiring and electrical maintenance. The instructor will work under the direction of the Professor of Physics of the University College, Bangor.

Applicants must state salary required.

Applications, with copies of three recent testimonials, must be sent to R. W. JONES, 14, College Road, Bangor, on or before JANUARY 4th, 1919, from whom further particulars may be obtained. 3713

POWER HOUSE SUPERINTENDENT.

SUPERINTENDENT wanted for Power House and Electricity Works. Must have had three years in similar position. Not more than 40 years of age, and have had thorough electro-technical training and mechanical experience. Salary, inclusive of all war bonus, &c., £350 per annum.

List of duties and conditions of appointment to be obtained from the BOROUGH ELECTRICAL ENGINEER, St. Peter's Chambers, Stoke-on-Trent. 3703

(*Continued on next page.*)

SITUATIONS VACANT.—*Continued.*

LEEDS TECHNICAL SCHOOL.

Training of Disabled Soldiers in Electrical Engineering.

THE services of the following are required :—

INSTRUCTOR to give technical and practical instruction for hand and former winding of armatures, rotors and stators for D.C. and A.C. machines for about 35 hours weekly ;

INSTRUCTOR to give technical and practical instruction for about 35 hours weekly. Should be a practical man, thoroughly familiar with all kinds of general installation work, wiring and care of electric plant.

INSTRUCTOR to give practical and technical instruction to disabled men training in electrical engineering for about 35 hours weekly. Should be used to bench and machine work in steel, iron, brass, &c., especially as required for electrical apparatus.

Applications, stating age, experience, salary required and how soon at liberty, should be submitted to the undersigned.

JAMES GRAHAM,
Director of Education.

Education Department,
Calverley Street, Leeds. 3702

CHARGE ENGINEERS.

CHARGE ENGINEERS required for small E.H.T. single-phase station.

Applicants should have had previous experience in the operation of turbines, high-speed engines and water-tube boilers.

Wages £2 17s. 6d. for seven 8-hour shifts per week, plus 12½ per cent.

Applications, stating age, married or single, to D.O., R.E., R.E. Office, South Camp, Ripon.

Copies of recent testimonials should be submitted. 3705

CHEMIST WANTED.

CHEMIST wanted at Generating Station in London district on large power plant. Experience in testing coal, water, oil, flue gases, &c. Must be acquainted with practical testing and economy work in connection with a large plant, and with the adjustment, minor repair and upkeep of flue gas and water recorders, softening plant, &c. Salary £200 to £250, inclusive of awards and bonuses to date.

Full particulars of recent experience to—

3659, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

TELEPHONE ELECTRICIAN.

WANTED, a Telephone Electrician for the maintenance of a large Tramways Telephone system. Must be able to test and do own repairs.

Apply, stating age, experience and salary required, to the—

GENERAL MANAGER,
Birmingham Corporation Tramways. 3663

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

A FIRM of electrical contractors in Leeds require a Working Foreman, used to all kinds of motor repairs, A.C. and D.C., &c., Please state experience and wages required.—3642, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A TECHNICAL Assistant wanted with experience in preparing and amending patent specifications.—Apply, stating age, experience and salary required, to 6498, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winder, used to all kinds of D.C. repairs.—STEPHENS, SMITH, 40, Cuba Street, Millwall, London. E. 6439

ARMATURE Winder wanted. Experienced man, used to D.C. and A.C. windings. Not repetition work.—WESTMINSTER ENGINEERING CO., Willesden Junction, N.W. 10. 3565

SITUATIONS VACANT.—*Continued.*

ARMATURE Winder wanted "working" to take charge of small shop, must be good all-round man used to large and small work A.C. and D.C. Good, progressive, and permanent job for an energetic man.—3699, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winders, used to repair shop, D.C. work.—Apply H. D. & S., 32, Newington Causeway, S.E. 1686

ARMATURE Winders wanted for South Wales accustomed to A.C. and D.C. repairs ; permanent job ; good wages to good men.—3618, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winders wanted in London works. Permanent positions for really first-class men.—3652, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winders wanted. Must be first-class men, accustomed to A.C. and D.C. repairs. Good wages.—Apply, LABOUR OFFICE, Ebbw Vale Works, Ebbw Vale, Mon. 3610

ARMATURE Winders wanted ; must be skilled men on A.C. and D.C. repairs ; wages district rates. — Apply, stating experience, to MCWHIRTER & SON (CARDIFF) LTD., Cardiff. 3698

ASSISTANT Electrical Engineer.—Wanted, thoroughly capable man as Assistant Electrical Engineer, for a large steel works on N.E. Coast. Applicants must have a thorough knowledge of A.C. and D.C. power requirements, be thoroughly conversant with high-tension work, including modern power station, sub-station and rolling mill equipments, and must also be capable of controlling men. Good prospects for a live six o'clock man.—Apply, stating age, salary required, and giving particulars of present employment and experience, and when at liberty, to 3630, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer wanted for Diesel engine station ; preference given to a good all-round man with Diesel, wiring and mains experience ; permanent post. — Apply, stating wages expected, to H. G. WRIGHT, Electricity Works, Saltburn-on-Sea. 3589

ASSISTANT Manager required for contractor's works ; lighting and power installation, estimating, interviewing, and used to the control of men.—MATHER BROTHERS, 23, 36, and 36a, Farringdon Street, London, E.C. 6513

ASSISTANT wanted in sales department of firm supplying special material to steel and chemical industries ; must be young and energetic ; some knowledge of electrical engineering preferable, but not essential ; a permanent position with good prospects for the right man.—6497, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CAPABLE and energetic young Electrical Engineer as Assistant wanted in technical office of London firm, manufacturing D.C. motor control gear. Must be conversant with motor control gear, and able to do correspondence.—Apply, stating age, experience and salary required, to the ELECTRICAL APPARATUS CO., LTD., Vauxhall Works, South Lambeth Road, London, S.W. 8. 6343

CHIEF Draughtsman required for transformer work by large engineering firm in the Midlands. Permanency for suitable man.—Apply, stating age, salary required and experience, to 3572, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CHIEF Electrical Assistant wanted for large works in Kent. Sound technical training and experience on estimating for, installation and upkeep of both A.C. and D.C. factory plants essential, experience in central station work or machine design not required.—Apply, stating age, salary required, and giving concise outline of training and experience (no testimonials will be returned), to 3711, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CONTRACTORS for electric lighting and power wiring work in Manchester, want an Assistant Engineer and Traveller. One who is used to such work is essential. Applications will be treated confidentially. State experience, age, salary required and when free. Good salary and commission will be paid.—3643, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN wanted for London, with electrical experience preferred. State age, qualifications and salary required.—3693, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

DRAUGHTSMEN required for transformer work by large engineering firm in the Midlands. Permanency to suitable men.—Apply, stating age, wages required and experience, to 3571, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMEN.—Wanted, several good men for works in London district, with Switchgear experience.—Reply, giving full particulars, stating age and salary required, to 3561, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (junior) required for electric manufacturer's H.T. test room, near Newcastle-on-Tyne. Must have good workshop experience.—Apply, stating age, qualifications and salary expected, to 3634, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN required to take charge of C.A.V. lighting on a fleet of 'buses. One with a knowledge of magnetos preferred. State wages, experience, &c.—TRAMWAYS COMPANY, Oxford. 3658

ELECTRICIAN wanted for maintenance of motors (D.C.), lighting, and telephones in large clothing factory.—Apply by letter, stating wages and experience, to HART & LEVY, LTD., Leicester. 6381

ELECTRICIAN wanted, thorough knowledge of the repairing and overhauling of all types of magnetos, lighting sets, starters for automobile work, by firm in large industrial town in Scotland. One able to take entire charge preferred. Every encouragement given to suitable man. State age, experience and salary required. Only experienced men need apply.—6452, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINE Driver wanted. Used to reciprocating engines and turbines.—Apply, with full particulars and experience, age, and enclose copies of testimonials, to THE NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3537

ESTIMATOR, junior, required for high and low-pressure switchboards, or Junior Draughtsman to train for estimator; must be accurate at figures.—3700, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

EXPERIENCED Foreman or Forewoman required to take charge of flashing and mounting department, carbon filaments.—9728, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FITTERS and Turners wanted. Used to engine and general repair work.—Apply, with full particulars and experience, age, and enclose copies of testimonials, to THE NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3536

FOREMAN Armature Winder, Yorkshire.—Wanted, first-class man for A.C. work in progressive works. Must be able to design own formers and able to control both male and female labour. New work only and not repairs. Would be required to commence duties about middle of January.—Apply, stating experience and salary required, to 3613, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN Dynamo Assembler required; one accustomed to all types of dynamos for lighting and starting systems; first-class electrical and mechanical experience essential; permanent position and good prospects to suitable applicant with good organising abilities.—Apply, giving full details of experience and salary required, to JOSEPH LUCAS, LTD., Great King Street, Birmingham. 3654

FOREMAN required, capable of carrying out repairs and taking charge of all plant in generating station; must have served apprenticeship as mechanical engineer and be able to handle alternators and rotaries.—Apply, with full particulars of experience, age, earliest date able to commence and salary required, to ENGINEER & MANAGER, Electricity Works, Barking, Essex. 3707

FOREMAN wanted by large engineering firm in the Manchester district to take charge of switchgear assembly section, including switchboards. Only those who have held similar positions on this class of work need apply.—Apply, with particulars of experience, age and salary required, to 3697, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN wanted for girls' department, well up in formers, all classes of coil work and small motors.—State experience and wages required, 3619, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

JOINTER-Wireman required for high and low-tension cables. Able to do plumbing. One with experience of car-wiring preferred. Wages £3 15s. for 56-hour week, inclusive of all bonuses to date.—Applications, with experience, when at liberty, and enclosing copies of testimonials, to RHONDDA TRAMWAYS CO., LTD., Porth, Glam. 6375

LIFT Repair and Maintenance.—Wanted, immediately in London capable Electrical Engineers accustomed to this work.—3554, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REQUIRED in drawing office (London) of company laying down plant at home and abroad, Man with General Knowledge of Electrical Machinery and experience of transmission line work and switchgear to develop layouts in connection with electrical equipment. Applicants to give particulars of experience and state age and salary required. — Write Z.A.225, care Deacons, Leadenhall Street, E.C. 3. 6473

REQUIRED, Telephone Faultsmen and Installers with intercom. experience. Good wages for good men. Permanency.—Apply between 9 and 10 any morning to I. T. C., LTD., 147/149, Great Portland Street, W. 1. 3397

REQUIRED, Traveller, with experience, for London district, for wholesale house of electrical accessories and fittings.—3415, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

STOKER wanted immediately. Wages, including war bonus 51s., plus CO_2 bonus.—Apply, with copies of testimonials, to the ENGINEER & MANAGER, Electricity Works, Canal Road, Worksop. 6503

STRONG Youth (16-17) wanted as a learner in electrical and general engineering under the engineer to a hotel. Quarters, food and small salary given.—Apply, Knowle Hotel, Sidmouth. 6482

SWITCHBOARD Attendants (H.T., A.C. and D.C. Boards) and Stokers (B. & W. Boilers and Chain Grates), wanted at once. Steady work for competent men. Full district rate plus full current war bonus. — Apply MANAGER, nearest Employment Exchange, or write, giving full details of firms worked with, length of service, age, &c., to BRITISH THOMSON-HOUSTON CO., LTD., Rugby. 3685

TECHNICAL Assistant wanted in electric lamp factory. Must have a thorough knowledge of all processes of manufacture of both drawn wire and carbon filament lamps, and be capable of speeding up output. Good opportunity for suitable man.—State age, experience and salary required, to 3651, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TECHNICAL Engineer, with first-class experience in the design and construction of miniature motors, fans, A.C. and D.C., &c.—Write, stating age, experience and salary required, to Box 223, Sells, Ltd., 168, Fleet Street, E.C. 4. 3622

TELEPHONE Engineer required having good technical education and experience of telephone exchange equipments: good prospects and salary for qualified man.—State full particulars to 3577, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TOOL Maker, one used to jigs for electrical controller gear. Some experience in armature coil formers an advantage. Permanent job for right man.—3694, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, a Designer for small Motors, &c., for electrical engineers' works near London.—Full particulars as to experience and salary required, to 3574, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, a working Foreman to take charge of Electrical Fitters. The persons submitted should be of good education and address, and have had experience in the control of workpeople, and should be well acquainted with the manufacture of switchgear, motor starters, &c. — 3691, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED at once, Shift Engineer for 14,000-KW. power station. Experienced in E.H.T., A.C. and D.C. Must be sound mechanical engineer. Good permanent position for capable man.—3627, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

WANTED, Charge Engineer, with experience with turbines; water tube boilers, and E.H.T. 3-phase. Starting salary £3 10s. per week.—Apply, giving full particulars and enclosing copies of testimonials, to 3538, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for India, Electrician with thorough practical knowledge alternating current, age about 26, single.—Apply by letter, stating age, experience and salary required, Z. E., 229, c/o Deacons, Leadenhall Street, London, E.C. 3. 6496

WANTED, for Lancashire Electricity Undertaking, Arc Lamp Trimmer, used to Johnson & Phillips and G.E.C. magazine arc lamps. Wages 7½d. per hour, plus 28s. 6d. plus 12½%. Also Electrical Fitter, used to repair to similar lamps. District union rate, plus 28s. 6d., plus 12½%.—3633, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Power Company, Engineer-in-Charge, with E.H.T. three-phase experience and good mechanical training. Wages £3 10s. to £4 per week, inclusive of all bonuses.—Apply, giving all particulars, to 3590, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for small electricity works, outside Foreman for L.T. V.B. and armoured mains work, wiring experience an advantage.—Apply F. C. PURSLOW, Electricity Works, Cromer. 3696

WANTED, for Yorkshire works, Electrical Designer for A.C. motors. This post will be a very progressive one for the right man.—Apply in the strictest confidence to 3621, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Improver in H.T.A.C.M.S., state age, wage, and experience. Experience in wiring necessary.—F. R. WINDSOR, Generating Station, Monmouth. 3488

WANTED, Manager for Switchgear and Motor Starter manufacturing department.—Reply by letter, stating age, experience and salary required, to WM. GEIPEL & CO., Vulcan Works, St. Thomas Street, London, S.E. 1. 3712

WANTED, Scottish Representative to take charge of Glasgow office; must be well-acquainted with all classes of D.C. and A.C. motor control gear, and should have had similar experience before.—Apply, stating age, experience and remuneration required, to THE ELECTRICAL APPARATUS CO., LTD., Vauxhall Works, South Lambeth Road, London, S.W. 8. 6462

WANTED, several good Armature Winders, for first-class repair shop.—T. P. POLLITT & CO., LTD., 9, Wellington Street, Hull. 3701

WANTED, several good Wiremen, factory work, 30 miles from London. — 3578, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Sub-station Attendant, Glasgow district; wages £15 per month.—3655, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, to go abroad, a young Telephone Engineer, with experience in administration, and thorough acquaintance with modern construction and apparatus and traffic methods.—Apply, stating age, experience and salary expected, to 3695, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMEN wanted. Permanency. Wages on basis of £3 6s. 3d. per 50-hour week, including all bonuses.—Reply, stating age and experience, to NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3606

WORKS Superintendent and Mains Engineer wanted for a 3,000-KW. Municipal Generating Station in Scotland, D.C. and A.C. generation and distribution. (1) Works Superintendent: Good mechanical and electrical experience. Capable carrying out all repairs and alterations, and of running economically the generating plant, consisting of turbines, engines, rotaries and water-tube boilers. (2) Mains Superintendent: Thorough training and experience in Mains work, capable of efficiently maintaining 3-wire D.C. high and low tension A.C. mains, and static transformer sub-stations.—Apply, giving age, married or single, salary expected, full particulars of training and experience, copies of recent testimonials, and date on which duties could be commenced, 3671, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

12 Electricians wanted for permanent engagement in large chemical works; standard district wages.—Apply, LABOUR OFFICE, British Dyes Ltd., Turnbridge Works, Huddersfield. 3626

SITUATIONS WANTED.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

A CONSTRUCTIONAL Supervising Electrical Engineer desires to get into communication with firms desiring his services now or in the near future. Ten years' experience of cable laying distribution work, ducts, solid, direct, &c., to 25,000 volts. Well up in power distribution for mills, steel works, &c., overhead transmission line erection, steel lattice poles, concrete, pine, &c., to 10,000 volts. Record work done South America, Portugal, France. Five years for English company. Conversant Spanish, Portuguese, French, Busque. Used handling large contracts, men and money. Will go anywhere on five years' agreement.—6367, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A TELEPHONE Engineer (age 39), with 25 years' practical and technical experience of switchboards, inter-communications, alarms and relay work, all installation systems, inclusive automatics and dictographs, good circuit designer, and quick faultsman; seeks change as department foreman, or travelling representative, to advise, estimate or rectify installations, distance no object. Substantial references. State best terms.—6382, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ACCESSORIES, cable, conduit, motors. Advertiser (38) seeks progressive berth, 14 years' experience charge, sales, order, dispatch, practical and technical experience, nominal salary.—6332, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, formerly managing engineer eminent London contractors, recently own business, 25 years' wide varied practical experience, seeks responsible position.—6409, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER (military officer) seeks to get into touch with concerns desiring to fill positions of superior responsibility. 15 years' experience covering factory planning and problems, railway signals, lighting and power, millwrighting, refrigeration, cranes, lifts and hoisting appliances, maintenance. Immediate interview.—6325, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN Engineer, exceptional training, 12 years' experience (electrical and mechanical), oil and gas-driven plant, power and lighting, layout, maintenance or installation, South preferred.—V. O. G., c/o G.P.O., Edinburgh. 6504

AN Engineer Lieutenant, R.N. (temporary), desires post as Chief Assistant in Supply undertaking. Responsible experience with modern plant of all types and sizes. Age 27. £250.—6364, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN ex-officer (R.E.), who before the war was chief Electrical Engineer to an important city abroad, E.H.T., 3-phase, lighting, power and traction, seeks engagement. He is a resourceful technician, live organiser, constructor and administrator, is capable, painstaking, well-recommended, and widely experienced in generating stations, power plant and lay-outs, underground, overhead and submarine mains, tramway overhead and track, rolling stock and workshops. Excellent testimonials.—6518, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMY officer (age 27), Electrical Engineer, A.C.G.I., A.M.I.E.E., desires to get in touch with principals, with a view to engagement. Shortly to be released from good military electrical post, held for past two years. Possesses energy and initiative. Not afraid of responsibility. All-round experience, including telephone work. Salary to be adjusted after first three months' employment. —6502, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer seeks situation abroad, Power Station (Diesel) and mains.—6429, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer (41), 24 years' experience large power and lighting installations, central stations, Diesel engines, telephone and lift installations, testing, workshop, office, commercial experience, control of men, initiative and business ability. 6410, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Shift Engineer (24), officer (ex service), energetic, trustworthy, experienced in A.C. and D.C. machines, fitting and draughtsmanship; held responsible position in three-phase, E.H.T. to D.C. sub-station, desires early engagement in similar position; Lancashire preferred. — 6416, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(*Continued on next page.*)

SITUATIONS WANTED.—*Continued.*

BUYER of one of the largest houses in the country, desires re-engagement, at liberty shortly, engineering, building, and other classes of material.—6336, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer, experienced, 46, seeks situation, country; charge of plant, late of large country house plant, steam gas, oil, Diesel engines, dairy, laundry, saw mills, pumping plants, repairs, overhauling, alterations or improvements.—6474, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer, fully trained (with special knowledge of Diesel plants, used to handling men and all classes of electrical and mechanical machinery), seeks responsible post.—6358, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, age 23, nine years' shop and drawing office experience on A.C. and D.C. switchgear, desires position as Assistant in Sales or Estimating Office. Highest references; state salary.—6407, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, aged 30, workshop, technical and commercial training; salesman; experienced in the design and invention of instruments; knowledge of switchgear, machines and W/T. Three years' commissioned flying service, electrical branch. Desires correspondence with a view to appointment.—Address S.W., Grosvenor House, Grosvenor Road, Weymouth. 6370

ELECTRICAL Engineer, cercificated, desires active position of trust. Wide practical experience in manufacturing and fitting, plant and installation work, controllers and lifts, extending over 28 years, possess a little sketching and drawing ability. Salary £195 per annum.—6459, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, naval certificated, theory and practical, seeks appointment on demobilisation, good references, adaptable, understand all branches.—6436, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (28) having been through workshops, now engaged technical department leading firm, seeks position where this experience useful.—Particulars, 6351, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (39), energetic, with 20 years' experience managing small power stations and doing installation work, wants appointment with prospects; North of England or London preferred; good saleman.—6477, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Mechanical Engineer (35) desires position abroad. Experienced steam, gas, Diesel, generating plants, A.C., D.C. Several years South America, nitrate production, control native labour, speaks Spanish, healthy and steady.—6442, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, experienced mechanic, lighting, bells, telephones and motor installations A.C. or D.C.—"ELECTRICIAN," 325, Kilburn Lane, Kilburn, N.W. 6481

ELECTRICIAN, practical mechanic, disengaged, requires charge country house electrical plant, own repairs, good references, 6 years last job.—M. G., 2, Alexandra Road, Dagenham. 6371

ELECTRICIAN requires permanancy, experienced installing, maintenance or factory, capable of charge.—FORMAN, 156, Green Lanes, Stoke Newington, N. 6511

ELECTRICIAN requires permanancy, used to erection and maintenance of factory and works plant.—6346, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, with long experience home and abroad on train lighting, desires change; Spanish spoken.—6512, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER (Mechanical 1st B.O.T.) seeks responsible post; experience in D.C. lighting sets and in auxilary plant erection in power stations; also in national gas engines; age 27; married.—6463, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS WANTED.—*Continued.*

ENGINEER, millwright, thoroughly reliable, been in charge of large works, doing own erecting, own repairs, both electrical and mechanical. Excellent testimonials. Age 36.—POWELL, 70, Standen Road, Wandsworth, S.W. 18. 6383

FOREMAN Electrican. Power, lighting, telephone. Can estimate and interview.—6422, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

R.E. OFFICER (32); Modern Technical University, A.M.I.E.E., A.M.I.Mech.E. (by exam.), offers services. Four years large central stations, four years lay-out, installation and maintenance of lighting, power, heating, ventilating, elevator, vacuum cleaning and pumping plant, two years (France) E.H.T. generating and aerial distribution, pumping, wood and metal shops, petrol, oil and steam engines, and turbines, correspondence, agreements, specifications and organisation. Would consider active partnership and investment in small sound business.—6433, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TELEGRAPH and Telephone Linesman, used to railway maintenance, seeks employment.—6516, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN, used lighting, arcs, bells, screwed tubes, desires permanency in London factory, where could gain experience motor repairs, maintenance.—6347, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN, used screwed tube, lighting, bells, testing, desires permanency where can gain experience motor repairs, maintenance. London.—6517, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WORKS Foreman (or Manager), 20 years' practical experience in A.C. and D.C. motor control gear, switchboard, &c. Accustomed to up-to-date methods of production, tactful and capable organiser. Large Works experience.—6365, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

YOUNG man requires situation as wireman or assistant. Age 17 years. Disengaged.—C. STEVENS, 213, Whippendell Road, Watford, Herts. 6515

PARTNERSHIPS.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

FIRM of Electrical Engineers in London about to extend their contracting branch, wish to negotiate with a gentleman who has an electrical business connection, on a commission or partnership basis. All office staff and expenses will be provided.—3404, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Provinces, practical man as partner in well-established manufacturing and factoring business of electrical and motor accessories. Good opportunity for right man. Capital required from £500 to £800.—6412, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).
Box Number and ELECTRICAL REVIEW address count as seven words.

A CABLE Agency.—Insulated wires and cables for electrical purposes. A London house of over quarter century's standing requires sole London and adjacent counties agency. Keen business house, having extensive connection and large storage accommodation. Negotiations with principals only.—6449, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A FULLY qualified Engineer (resident Glasgow), having established connection with corporations, works, collieries, desires additional agencies. (Cables, earthenware conduits, electric motors) for Scotland.—6495, ELECTRICAL REVIEW, 4, Ludgate Hill, London

(*Continued on next page.*)

AGENCIES.—*Continued.*

AGENCIES wanted.—Two gentlemen, with expert technical and commercial experience and influential connections with shipbuilders, engineers, are prepared to represent manufacturers of standing.—3681, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BELGIAN Electrical Engineer would like Agency for Belgium, for A.C. and D.C. motors, starters and labour-saving machinery. Very good trade prospects.—6510, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BELGIAN firm wants to represent in Belgium and North of France, English manufacturers of everything electrical, Motors, Cables, Accessories. Free use of large stores and showrooms will be put at disposal of firms wishing to place goods in stock against bank deposit. Best references. First class firms only to apply.—6438, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BELGIUM.—Electrical engineer (Belgian discharged soldier), good technical and practical training, 10 years' experience in electrical installations in Belgium, France, England, going back to Belgium shortly, would like to hear of British firms desirous to start business or agencies there.—A. COLLUMBIEN, 2, Woodlands Road, Cheetham Hill, Manchester. 6354

COMMERCIAL and Practical Electrical Engineer, with valuable connection in Lancashire and Yorkshire, offices and stores in central position, Manchester, open to consider Agencies of high-grade Electrical Supplies for manufacturers.—6401, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (39), with varied experience, including telephones and telegraphs (manual and automatic), desires sole representation of first-class firm in France, Italy, or near East, immediately on discharge from army. Pre-war foreign experiences. —6432. ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GLASGOW Electrical Firm is desirous of representing manufacturers of Electrical Specialities, Labour-saving Tools, &c. Excellent showroom, storage accommodation and connection.—6200, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MECHANICAL, Electrical and Business Engineer, established in London many years, with good office in central position, requires another first-class firm to represent. Cables, motors, or similar specialities preferred.—6506, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

OLD-established electrical firm, with offices and stores in London, are open for agencies. Good connection among engineers, architects, builders and householders.—3553, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR SALE.

COUNTY BOROUGH OF BOLTON.

Electricity Department.

PLANT FOR SALE.

THE ELECTRICITY COMMITTEE have for disposal Two 2000-H.P. Steam Engines, complete with Barometric Condensing Plant and 3-phase, 50-cycle, 6600-volt Alternators.

Full particulars and Specification of Plant may be obtained on application to the BOROUGH ELECTRICAL ENGINEER, Back-o'-th' Bank Generating Station, Bolton.

Tenders endorsed "Sale of Plant," addressed to the Chairman of the Electricity Committee, Town Hall, Bolton, must be delivered to the undersigned not later than 12 noon, JANUARY, 15th, 1919.

The Committee do not bind themselves to accept the highest or any Tender.

SAMUEL PARKER,
Town Clerk.

Town Hall, Bolton,
December 16th, 1918. 3666

ELECTRICAL PLANT FOR SALE.

ONE 300-KW., 220/250-volt Generating Set, comprising "Howden" enclosed compound engine, coupled to compound interpole Generator.

One 500-KW., 220/250-volt Generating Set, comprising "Bellias" enclosed compound engine coupled to compound-wound Generator, and complete with condensing plant.

One 450-KW., 500-volt Set, as above, with or without condensing plant.

THE PHŒNIX ELECTRICAL CO.,
32—36, Broomielaw,
Glasgow. 2429

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

9½ IN. centres Self-acting S.S.S. Lathe, on 8 ft. bed, by John Stirk & Sons.
10¼ in. centres S.S.S. Lathe on 8 ft. bed, by Bramam Smith.
"Rockford" full universal Milling Machine, working surface of table 3 ft. 4 in. × 12 in.
Parkinson No. 2 Model H Universal Milling Machine.
Double-geared self-act S.S.S. Lathe, 12 in. centres on 12 ft. gap bed, by Wm. Asquith, Ltd.
Compound-wound Bi-polar Dynamo, by Scott & Mountain, 220 volts, 450 amps., 550 revs.
25-KW. Direct-coupled Generating Set, two crank comp. Engines, by Mather & Platt, two pole Dynamo, 100 volts, 250 amps., 450 revs.
15-B.H.P. portable Oil engine, by the Advance Co., with cyl. 10½ in. diam. by 12 in. stroke.
Hori. Corliss Engine, by Hick, Hargreaves & Co., 18 in. cyl., 36 in. stroke.
Two crank single-acting Vertical Engine, by Alley and MacLellan, 8½ in cyls. by 7 in. stroke.

CATALOGUE of Stock MACHINERY. 2-3000 LOTS.
Free on Application. Inspection invited.

THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

R. H. LONGBOTHAM & CO., LTD., WAKEFIELD,

and at Milburn House, Newcastle-on-Tyne.

Tel.: 44 Wakefield. 867 Newcastle. Telegrams: "Engineer, Wakefield."

FOR SALE.

ONE 500-KW. triple-expansion Set, engine by Browett and Lindley, H.P. cyl. 17½", I.P. 25", L.P. 35" × 14" stroke. Single-phase Alternator, by British Westinghouse Co., 2100 volts, complete with exciter, &c.

One 225-KW. Generating Set, engine tandem comp. type, 300 H.P., with Corliss Valve Gear, &c., B.T.H. Generator, 500 volts, compound wound.

One Parsons Steam Turbo, 1500 KW., 2-phase, 2000 volts, 50 periods. Complete with condensing plant.

One Willans-Parsons Steam Turbo Set, 1200 KW., with Alternator, 1200 R.P.M., 200 lbs. to sq. in., 11,000 volts, three-phase, complete with exciter, also condensing plant, air, and circulating water pumps, &c.

Two Hopkinson Coal Cutters, electrically-driven, 450/500 volts, D.C., undercut 5' 6".

Two Diamond Coal Cutters, electrically-driven, 25 H.P., 500 volts, C.C., undercut 4' 6". 5277

GAS ELECTRIC PLANT.

FOR Sale, the following Gas Electric Plant, which is being superseded for a more extensive supply :—

One practically new Mond Gas Producer, 1200 B.H.P. continuously, for supplying Mond gas for driving gas engines, and supplying gas for furnaces, complete with Coal Handling Plant. Available now.

Three 105-KW. Hindley 5-cylinder vertical Gas Engines, direct coupled to 500-volt D.C. Generator. Available now.

Two 180-KW. do. do., in process of manufacture.

One 35-KW. do. do., just delivered.

Two 205-B.H.P., 500-volt Motors, 290 revs., suitable for direct coupling to Compressors.

One compound-wound Generator, 310 amps., 240 volts, 540 R.P.M.

One compound-wound Generator, 128 amps., 250 volts, 900 R.P.M.

For further information apply to MESSRS. TELFORD, GRIER AND MACKAY, LTD., 16, Carrick Street, Glasgow. 3190

MACHINERY, &c., FOR SALE.

FOR Sale, Generator or Motor, 110-volt, 164 amps. D.C., 950 R.P.M., three-bearing machine.

1, 5, 10, 15, 18, 25 and 30 H.P., D.C., 220 V. and 440 V.

1, 2, 3, 5, 10, 15, 25, 30, 35-H.P., A.C., 2 and 3-phase, 220 and 440 V., Starting and Switchgear.

Four miles 1/18, five miles 3/22, 3/20, 7/20, 7/18, 7/14, 7/16, 19/16, 37/16, Association and Non-Association, 600 meg.

D.P. and T.P. Switch Fuses, 15 to 200 amp. D.P. Fuse Boards, 10/20 amp. per way. Iron-clad, Home Office Pattern, 4 to 12 way.

Immediate delivery and all guaranteed. In stock for inspection. Your enquiries please.

"ROBUST MACHINERY,"
62, Bradford Street, Walsall. 3563

(Continued on next page.)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

D.C. MOTORS.

H.P.	Volts.	R.P.M.	Windings.	Makers.	Type.
30	400/440	850	Shunt intple.	Royce Bros.	Encl's'd, v'ntilat'd.
27	460/480	950	" "	Brush Elec.	" "
20	440/460	750	" "	Bruce Peebles	" "
20	440/460	1250	" "	E.C.C.	Tot. en., pipe vent.
15	230	800	" "	Royce Bros.	Encl's'd, v'ntilat'd.
13	400/420	1000	Shunt wo'nd.	Mather&Platt.	Totally enclosed.
12	200/220	950	" "	Cutting Bros.	Encl's'd, v'ntilat'd.
10	420	1000	" "	Electromotors.	" "
10	400/440	750	Shunt intple.	"	Totally enclosed.
9½	400/460	750	" "	E.C.C.	" "
8	230	480	" "	Royce Bros.	Encl's'd, v'ntilat'd.
8	440	950	Shunt wo'nd.	Gen. Elec. Co.	Tot. en., reversing.
7½	440	880	" "	Siemens Bros.	Encl's'd, v'ntilat'd.
7½	230	880	" "	" "	Totally enclosed.
5	230	880	" "	" "	Encl's'd, v'ntilat'd.
5	440/460	1200	" "	Cutting Bros.	" "
4	400	1150/1835 variable.	" "	Gen. Elec. Co.	" "

A.C. MOTORS.

H.P.	Volts.	R.P.M.	Periods.	Phase.	Makers.	Type.
30	400	750	50	Three.	Clayton Motors.	Encl's'd v'ntilat'd.
12	420	960	50	"	Gen. Elec. Co.	" "
10	440	950	50	"	Brook & Co.	Tot. en., pipe vent.
5	420	1450	50	"	Wright & Wood.	Encl's'd v'ntilat'd.
3	420	1450	50	"	" "	" "

GENERATORS.

17 KW., 230 volts, 1200 R.P.M., shunt wound, Holmes & Co., makers, enclosed, ventilated type.
300 watt, 160 volts, 1250 R.P.M., shunt wound.

YARNALL & CO.,
Cornwall Street Ironworks,
Openshaw, Manchester. 3259

FOR SALE.

12-VOLT DYNAMO, 750 amps., two Commutators, 1150 revs. Almost new. Makers: Canning & Co.

140-volt Dynamo, 50 amps., 1030 revs. Makers: Greenwood & Batley.

Transformer, 3-phase, 500 to 220 volts, 50 periods; output, 15 K.V.A. continuously. Secondary pressure can be changed easily to 110 volts. Makers: Ferranti.

Alternating Motor Starter, large size. Makers: Erskine, Heap & Co.

55 yards double-wire armoured, 19/16 three-core Cable, Association; 2500 megohm grade.

Particulars from—

JAMES NEILL, LTD.,
1, College Place North,
Belfast.
3513

ELECTRIC PLANT.

MAGNIFICENT 500-H.P. Horizontal Tandem Gas Engine, together with 350-KW. Alternator, by G.E.C., 230 volts, three-phase. Price £2,500. Set will be sold separately if desired.

One 300-KW. Alternator, by the Westinghouse Co., 2400 volts. Price £600.

One 250-KW. Belt or Rope-driven Multipolar Generator, by B.T.H. Co., 500 volts, D.C., compound wound; a very fine machine. Price £575.

One 100-H.P. Belt or Rope-driven Multipolar Generator or Motor, by Parker, 230 volts, D.C., compound-wound. Price £250.

Six 25-H.P. Traction Motors, series wound, 500 volts, by G.E.C. Price £75 each.

One 8-H.P. Series-wound Motor, 500 volts. Price £30.
One 6-H.P. Series-wound Motor, 230 volts. Price £25.

JOHN F. WAKE, Engineer, Darlington. 3145

GENERATING SET FOR SALE.

ONE 50-KW., 440-volt, 3-phase, 30-cycle, 8-pole, two bearing Alternator for belt drive, with separate belt-driven exciter and pulley.

One compound drop valve, horizontal Robey Engine, 70 H.P. cylinders 9¼", 15½" × 20" stroke, 120 lbs. steam pressure, with flywheel 9' dia. × 13" face, complete with Condenser.

One Switchboard for above generator complete with ammeters, voltmeters and tripole switches and fuses.

Above plant new 1902, in excellent condition; seen running in Lancashire; offers requested for whole or part of above.

Apply—
HARLAND ENGINEERING CO.,
Manchester. 6509

FOR SALE.—*Continued.*

ELECTRICAL PLANT (220 Volts, D.C.) FOR SALE.

OWING to the Mill being converted to A.C. system, the following plant in good working condition is offered for sale, ready for delivery early in 1919. The Generators and Motors are mostly of Lancashire Dynamo Co.'s make:

GENERATING PLANT.—One 280-KW. and one 80-KW. direct coupled high speed Steam Sets.
Two 66-KW. Generators for belt drive.
One M.G. Set, converting 220 volts D.C. to 220 volts, single phase, A.C., 5 K.V.A., 50 periods.

MAIN SWITCHBOARD.—Comprising one 1200 and three 600-amp. Circuit Breakers, 4 Ammeters, 3 Voltmeters, 4 Wattmeters, and 3 Field Regulators, together with one 3-way and one 2-way Panels with Switches and Fuses.

MOTORS.—Each complete with Starter, Switch and Fuses; also in many instances an Ammeter is provided:

Two 3/4	B.H.P., at	600	R.P.M.	Three 20	B.H.P. at	360	R.P.M.
One 2	"	1150	"	One 20	"	420	"
Two 3	"	1280	"	Five 20	"	600	"
One 3¾	"	600	"	Three 27	"	360	"
One 10	"	600	"	Two 28	"	720	"
One 13	"	1100	"	One 65	"	420	"
One 15	"	1400	"	One 75	"	—	

Also Special Motors for driving Hydro-Extractors (Broadbents), five 12 B.H.P., three 8 B.H.P., and one 5 B.H.P., each complete with starter and switch.

The above plant may be seen by appointment. Application to be made to—

BURGESS, LEDWARD & CO., LTD.,
Wardley Mills,
Walkden, near Manchester. 3620

FOR IMMEDIATE SALE.

THREE A.C. Generating Sets, comprising compound double-acting high-speed Engines ("Sentinel"), 220 B.H.P. each, coupled direct to 150-KW. Generators (Westinghouse), 440 volts, 25 periods, three-phase.

Two D.C. Generating Sets; compound, double-acting high-speed Engines ("Sentinel"), 45 B.H.P., coupled direct to 30-KW. Generators (Westinghouse), volts 250.

Four Durr Water-tube Boilers, 1614 sq. ft. H.S. each; working Press 120 lbs. per sq. in.

One Main Switchboard and Accessories, &c.

All in good order.

For further particulars, apply to WM. D. HAMILTON, Consulting Engineer, 59, Bath Street, Glasgow. 3239

WHAT OFFERS FOR PRESSED M.F. LAMPS?

1800, 12 volts, 8-C.P., Pear. 2100, 12 volts, 10-C.P., Pear.
1300, 20 volts, 16-C.P., Pear. 300, 125 volts, 16-C.P. Pear.
380, 130 volts, 18-C.P. Pear. 10 doz. Leclanché 3 Porous Pots.

Write 6447, ELECTRICAL REVIEW,
4, Ludgate Hill, London, E.C. 4.

NEW MOTORS AND GEAR.

1, 2, 5, 8, 10, 15, 20, 25, 30 H.P., A.C., 2 and 3-phase; also D.C., 220 v., and 440 v., complete with Starting and Switch Gear. Lighting and Power Home Office Distribution Fuse Boards. Cable 1/18 to 37/16 C.M.A. and non-Association, 600 megh. Immediate delivery. Guaranteed 18 months.

"ROBUST MACHINERY," 62, Bradford Street, Walsall. 3314

LAMPHOLDERS, DELCOBLAST, &c.

FOR Sale at reasonable prices, from stock, Lampholders, Switches, Cables, Delcoblast Lamp Obscurer, &c., &c.

DAVIS, 11, Sun Street, E.C. 2. 2780

MOTORS AND DYNAMOS.

MOTORS and Dynamos, new and second-hand, large number for sale, all guaranteed.

THE VICTORIA ELECTRIC PLANT CO.,
Spenser Street, Westminster. 3330

ARC LAMP CARBONS.

50,000 PAIRS of 12" × 9 m/m and 13 m/m.
20,000 pairs of 12" × 12 m/m and 18 m/m.

Manufactured by the General Electric Co., Ltd.

3683, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

(Continued on next page.)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

TURBOS AND GENERATING SETS.

1000-KW. Turbo-Generator, A.E.G., 500 volts, 50-period, 3-phase, complete with two switch panels, surface condenser, electrically-driven air and circulating pumps, together with the piping and a quantity of new spare parts. The whole practically equal to new and ready for immediate despatch at Liverpool.

500-KW. Parsons Steam Turbo, 460/500 volts, D.C., in perfect condition, and complete with condensing plant.

Also 256, 200, 185, 160, 120 and 48-KW. Belliss Generating Sets, 460/500 volts and 220 volts, D.C.

One 200-KW. Allen-Holmes-Clayton, 500-volt, 50-period, 3-phase.

MOTORS.

One Crompton, 150 H.P., 25 periods, 3-phase, slip-ring.

Two 26-KW. 220/230-volt Generators, 200 R.P.M., each fitted with half coupling.

One Westinghouse, 14 H.P., 350/400 volts, 50 periods, 3-phase, slip-ring, 940 revs.

One Phœnix, 290 H.P., 460 volts, D.C., 400 revs., three bearings.

All the above are ready for immediate despatch.

Apply FRANK GILMAN, 9, Westfield Road, Birmingham.

Telegrams: "Rotherwood, Birmingham." Telephone: 1081 Edgbaston. 2128

MACHINERY FOR SALE.

ONE Generating Set Comprising:—

"Howden" Enclosed Compound Engine for 150 lbs. steam pressure, direct-coupled to compound interpole generator, having an output of 300 KW. at 240 volts, 375 r.p.m.; built in 1910, and in first-class order.

Specification and print on request.

THE PHŒNIX ELECTRICAL CO.,
32—36, Broomielaw, Glasgow. 1943

FOR SALE.

250-KW. Belliss-E.C.C. Set, comprising Belliss high-speed, 3-crank, compound engine, direct-coupled to E.C.C. generator, 440/460 volts, D.C., 560 amps., 380 R.P.M., with Körting ejector compound, also spare armature. Can be seen running by appointment.—BURY ELECTRICAL PLANT CO., LTD., Phœnix Street, Bury. 2746

SPECIAL MOTOR AND GEAR.

40-H.P.. D.C., 440/500 v., back gear, silent pinion; complete with starting panel, D.C. starter, switch fuses and meter.

30-H.P. Interpole Machine, D.C., 440 v., complete with D.A. starter and switch. Immediate delivery guaranteed.

"ROBUST MACHINERY,"
62, Bradford Street, Walsall. 3313

CUNNINGHAM'S REGISTER.

A REGISTER OF MOTORS, &c., for sale and wanted. No charge is made.

Send particulars of YOUR NEEDS (as a buyer or seller).

171, Edgware Road,
'Phone: Padd. 5173, London, W. 2.

CUNNINGHAM, LIMITED.

SMALL Motors and up to 300 H.P. rewound and repaired.

Estimates free. 171, Edgware Road,
'Phone: "5173 Padd." London, W. 2.

BATTERY AND GENERATING SET.

BATTERY.—One new 207-ampere hour Battery for sale, complete with Insulators, Stands, &c., as received from makers' works (not unpacked).

Also direct-coupled Petrol Electric Generating set for charging.

FYFE, WILSON & CO.,
31, Budge Row, E.C. 4. 3629

MOTORS FOR SALE OR HIRE.

MOTORS ready for immediate delivery: 15 H.P., 220 volts, 900 R.P.M.; 7 H.P., 500 volts; 7½ H.P., 480 volts; 10 H.P., 220 volts; 5 H.P., 440 volts; 5 H.P., 500 volts; 5 H.P., 220 volts; 5 H.P., 110 volts; and 24 smaller D.C. Motors. Two 2-pole Generators, two Auto-Converters, and 15 A.C. Motors.—E. P. ALLAM AND CO., 107/109, Gray's Inn Road, W.C. 1. Holborn 1280. "Epaltrical, London." 3647

ELECTRIC DYNAMOS AND MOTORS.

MACHINES always available for Sale or hire. ARMATURES and FIELD COILS rewound or repaired without delay.

'Phone: 5773 Holborn. MACDONALD, SYER & CO., LTD., 295, Gray's Inn Road, W.C. 1. 8485

FOR SALE.—*Continued.*

GENERATORS.

125-KW., 500-volt, 650-R.P.M., Crompton Interpolar Generator, belt-driven from Robey single-cylinder Engine, 16" × 30" link govenor. Both in exellent condition, replacing with larger unit.

200-KW., 500-volt, 375-R.P.M. Crompton Interpolar Generator, rope-driven from 2-cylinder Engine, Pickering governor. Both in good condition. Sets can be inspected by appointment.

All enquiries to be addressed to—

W. WALTER HUGHES & ASSOCIATES,
12, Cambrian Place, Swansea. 3511

Cheap prepaid Advertisements relating to second-hand goods and specified Articles are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).

TRADE RATES ON APPLICATION.

Box Number and ELECTRICAL REVIEW address count as seven words.

CROMPTON Potentiometer in good condition with standard resistances up to 300 volts and standard shunts for 1·5, 15 and 150 amps.—Full particulars on application to CHAMBERLAIN AND HOOKHAM, LTD., 4, New Bartholomew Street, Birmingham. 3644

DYNAMOS, 3000, 1500, 1000 and 750 amperes at 6 volts; also smaller sizes. Apply for lists.—CANNING & CO., Electro-Platers Engineers, Birmingham. 7769

ELECTRIC Plant for Sale.—100-KW. Generating Set: High-speed Vertical Compound Engine, 11" and 16" × 10", by Browett, Lindley, coupled direct to D.C. Laurence Scott Generator, 460 volts, 220 amps., 400 R.P.M.; equal to new. 16-KW. Generating Set: Inverted Vertical Engine, 7½" × 6", coupled direct to D.C. Generator, 100 volts, 160 amps., 500 R.P.M.. by Cromptons.—R. H. PATTERSON & CO., LTD., Forth Street Works, Newcastle-on-Tyne. 3591

EXHAUST Steam Turbine Generating Set, direct coupled to E.C.C. Dynamo, 200 KW., 440/500 volts, D.C.; condenser, motor-driven circulating and air pumps, switch panels, and steam and exhaust piping; forming a complete plant; low price. One 200-KW. Steam Generating Set, for immediate sale; Willans-Mather and Platt, 220 or 440 volts; perfect working condition.—JENNINGS, West Walls, Newcastle-on-Tyne. 3560

FOR Sale, Motor-Generator, by Westinghouse, 500 volts, Motor coupled to 110-volt, 300-ampere, compound-wound Generator, suitable for welding or as battery booster.—The PHŒNIX ELECTRICAL CO., 32/36, Broomielaw, Glasgow. 3588

FOR Sale, 6 Four-lamp Radiators, copper and black; perfect condition; very cheap.—"ELECTRICIAN," 145, High Holborn. 6514

FOR Sale, 30-H.P., D.C., 440-volt Motor, 680 R.P.M. Nearly new. Can be seen running.—Apply, E. T. MACKRILL & SONS, Aylesbury. 3517

FOR Sale, 1000-KW., 500-volt, D.C. Turbo-Generator and auxiliaries, new 1912, and in first-class condition.—THE PHŒNIX ELECTRICAL CO., 32/36, Broomielaw, Glasgow. 3587

GENERATING Set, 22-KW., 220 volts, Brotherwood, B.T.H., 120 lbs. pressure.—MARTINS, 320, Witton Road, Birmingham. 6377

SINGLE-Phase Motors: 25-H.P., 200-v., 83-cycle, slip-ring type, by Crompton, pulley and starter; ½-H.P., 100-v., 83-cycle, self-starting type, by Bergteil & Young. Guaranteed.—J. MELLING, 8, Dorset Street, Bolton. 6486

STORAGE Batteries, by Chloride Co., for Sale: Two 28-cell Batteries, two 56 and one 112-cell ditto, each cell consisting of 17 plates in glass boxes, and complete with stands, &c.—THE PHŒNIX ELECTRICAL CO., 32/36, Broomielaw, Glasgow. 3668

STORAGE Batteries for Sale. One Chloride traction battery comprising 250 33-plate cells in teak boxes; also lighting battery of 280 17-plate glass cells. All in perfect condition.—THE PHŒNIX ELECTRICAL CO., 32/36, Broomielaw, Glasgow. 3611

(Continued on next page.)

FOR SALE.—*Continued.*

"THE Electrician," 21 volumes, for sale, dating 1884 to 1894; also "Engineering," seven volumes, dating 1887 to 1890. All bound and in good condition. What offers?—6326, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TRANSFORMER, 5000/100 volts, 3-phase, 25 cycles, oil-cooled, 10 K.V.A. British Westinghouse make; in perfect condition; just replaced by larger size.—BAXTER & IMPEY, Dudley Street, Birmingham. 6501

10-H.P., 110-volt, Westinghouse, 4-pole Shunt Motor; also 8-H.P. ditto.—DRUMMOND & Co., Middlesbrough. 6445

17-H.P., 440-volt, Shunt Protected Westinghouse Motor; speed 1500. Also 19-H.P. ditto.—DRUMMOND & Co., Middlesbrough. 6329

56-KW., 700-amp. Welding Dynamo, multipolar, belt-driven type, complete with spare armature.—DRUMMOND & Co., Middlesbrough. 6328

70-B.H.P. Motor for sale, shunt and light compound wound 440 volts, 130 amps., 580 R.P.M., including standard pulley, slide rails and Brook-Hirst starting panel, with amperemeter and D.P. circuit-breaker: all in perfect condition; new April, 1917.—3692, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

120-VOLT, 400-amp., 4-pole, shunt-wound Dynamo, three bearing, belt-driven type.—DRUMMOND & Co., Middlesbrough. 6446

150-KW., D.C. Generator, multipolar type, 500 volts, with rope pulley; splendid condition.—HARRY H. GARDAM AND Co., LTD., Staines. 2952

190-H.P., six-pole D.C. Motor, by Ernest Scott & Mountain, 500 volts, arranged for rope drive.—HARRY H. GARDAM AND Co., LTD., Staines. 2827

250-KW. Steam Set, comprising Belliss engine, direct coupled to Silvertown dynamo, 500 volts, D.C. Available for prompt delivery.—HARRY H. GARDAM & Co., LTD., Staines. 3435

300-AMP. Welding Dynamo, bi-polar, by Holmes, Newcastle. In new condition.—DRUMMOND & Co., Middlesbrough. 6444

BUSINESSES FOR SALE AND WANTED.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

ENGINEERING Works in London, S.E., for Sale. About 40 machines suitable for the manufacture of electrical accessories.—Can be seen by appointment on application to 122, New Kent Road, S.E. 6461

ARTICLES WANTED.

STOCKS PURCHASED.

STOCKS of Cable, Bell and Lighting Accessories, Lamps, &c., purchased for cash. Large and small quantities.

DOUGLAS, Dunedin House,
Basinghall Avenue, E.C. 4. 2675

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).
Box Number and ELECTRICAL REVIEW address count as seven words.

ACCUMULATORS wanted for refining purposes. Obsolete Generating Sets, Dynamos, Motors, and all kinds of Machinery. Scrap Cable, Arc Lamps, Meters, Metal Residues, and Scrap Metals of every description purchased for prompt cash, town or country.—Apply A. BROWN & SONS, 142, Lower Clapton Road, London, N.E. Telephone: Dalston, 555. Telegrams: Secondhand, Lowelap, London. Established 1860. 4358

ARTICLES WANTED.—*Continued.*

ANY Obsolete Electrical Plant, Machinery, Dynamos, Motors, Accumulators, Arc Lamps, Meters, Old Cable, Iron and Metals wanted for cash.—JOHN HYAMS, 11, Glengall Terrace, Old Kent Road, S.E. 15. 6264

A1 CASH Prices given for Electric Cable, Flexible Wire, Electrical Accessories, &c.—Apply DAVIS, 11, Sun Street, E.C. 2. 1424

NEW or Second-hand Tubing and Fittings wanted.—WALLACE, 58, High Street, Bloomsbury. 2307

OLD Lamp Caps, 80,000 for sale, all suitable for reclaiming.—Samples and prices from HAMPSON'S LAMP CAP DEPÔT, 141, Higher Cambridge Street, Manchester. 6427

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London.

PLATINUM Scrap purchased in large or small quantities. Highest market value given.—Before selling elsewhere call or post to the old and reliable firm, THE DEPÔT, 156, Charing Cross Road, London. Established 1850. 6353

QUANTITY of Flexible Lighting Strip, waterproof, in good condition.—Particulars to HARRIS, 178, High Road, Kilburn, N.W. 6. 6284

WANTED, a few 400-volt, 50-cycle, 3-phase Motors, preferably slip-ring type, 5 to 35 H.P.—8133, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, direct-coupled Set, about 50/75 KW., 220 or 440 volts, D.C., preferabl the latter. Full details and price must accompany offer.—2828, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Electric Cooking and Heating Apparatus, Kettles, Irons, Vacuum Cleaners, all voltages. Also Electric Bells, Lamps and Arc Lamp Carbons, and all classes of Accessories and Flexibles. — Fullest particulars to 6048, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, new or good second-hand 110-volt D.C. Compound Wound Generator, 30 H.P.; approximately 1000 R.P.M., belt-driven.—3510, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Secondhand Motor, 5 or 6 B.H.P., 500 volts, 50 periods, single-phase, starter and slide rails.—Apply PITCHER, 57, Ashburton Grove, Holloway, N. 6426

WANTED, several large Motors, 100 to 150 H.P., 460 volts, D.C.—6244, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Steel Poles, about 27' long, bottom 6", top 4".—Particulars and price to ELECTRICITY WORKS, Northallerton. 3710

WANTED to Purchase.—Electric Hoist, 15 cwt. minimum lifting capacity; cage, 6 ft. × 8 ft. × 7 ft. high; motor, 440 volts A.C., three-phase, 50 periods.—Send full particulars and price to 3657, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, two good, second-hand, direct-coupled Engine Alternators, each 200 or 300-KW. capacity, 3-phase, 50 periods, any voltage; also independent surface Condensing Plant suitable for above, and two or three Babcock & Wilcox Boilers, each capable of generating 10,000 to 12,000 lbs. of steam per hour.—Apply, with full details, to EDMUNDSON'S ELECTRICITY CORPORATION, 11, Tothill Street, London, S.W. 1. 6500

WANTED, 2½-KW., direct-coupled Set. Engine to run on paraffin.—E. T. MACKRILL & SONS, Aylesbury. 3531

WE are buyers of all descriptions of Scrap Iron, Steel, Brass Copper and other metals and residues, Rubber, Gutta, &c. All classes obsolete plant, machinery, &c., Building Materials, Timber, &c. Works, Collieries, Manufactories, Buildings, Railways, Bridges, Viaducts, &c., of all kinds for dismantling.—JOHN JACKSON & Co., LTD., Balmoral Street, Scotstoun, Glasgow. 6135

(*Continued on next page.*)

MISCELLANEOUS.

HEWLETT & BLONDEAU, LTD.,
Omnia Works, Leagrave, Beds,

DESIRE to obtain the manufacture of specialities in their Engineering Works, which have been recently constructed on the most modern principles, well-equipped with a large number of new Machine Tools, with Hardening and Annealing Furnaces, Welding, Presswork, Tubework, and Sheet Metal Plant, up-to-date Woodworking Department. Every attention will be paid to any proposals received.

3504, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

TO ELECTRIC RAILWAY AND POWER TRANSMISSION ENGINEERS.

A FIRM of Manufacturing Electrical Engineers, with up-to-date plant recently occupied on scientific instruments for M.O.M., is anxious to acquire manufacturing rights for Specialities for Sale amongst Electric Railway and Power Transmission Undertakings. Write—

HALSE, TRUSTRAM & CO., 61, Cheapside, E.C. 2. 6499

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

AN important and progressive South African firm of Merchants, with special electrical department, wishes to represent manufacturers of Electrical Railway Materials, Electric Vehicles, Automatic Telephones, Electro-medical Apparatus, Switchgear and/or other articles for electrical industry. Exceptional opportunity. Branches throughout the country.—Write, giving full particulars, to "ELECTRICAL," P.O. Box 447, Cape Town, South Africa. 3709

LARGE Northern Factoring Firm, in view of next season's catalogue, desires to get into touch at once with actual makers of miniature electrical accessories, model lighting sets, water motors, medical coils, electrical novelties, bell sets, &c.—3704, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WILL British Isles representatives of American, Japanese, Swedish and Swiss manufacturers of electrical accessories, &c., kindly communicate with advertiser with a view to business.—3673, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMPUTING THE SPEED
OF
RECEIVING A TELEGRAPHIC MESSAGE.

Sent by Hand-Key or Automatic Transmitter.

By J. Rymer-Jones, M.I.E.E.

Price 4s. net.

THE method determines the *actual* number of *signal* and *spacing* elements received per minute, and excludes any abnormal spacing between words, or groups of numerals, the presence of which affects the time factor in the formula. The speed can therefore be correctly evaluated in terms of (say) 5, 7, or 10-letter words per minute by using their respective *speed constants* as the denominator; or else in "standard words," for *universal* comparison, by employing a recognised number of elements per 5-letter word.

Illustrated by practical examples obtained with the syphon recorder and Morse recorder.

The treatise contains, among other data, a comparison between the speed efficiency of the *International* and *American* codes.

Published by

The ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4

NOTICE.

OWING to the many hundreds of replies passing through this Office each week, we would ask those answering Advertisements to be EXTREMELY ACCURATE with regard to the figures WHEN ADDRESSING REPLIES to Box Numbers.

SEVENTH EDITION.

Limp Cloth, cut flush, round corners, red edges, demy 12mo, suitable for pocket (size 7 by 4½). 124 pages. 77 illustrations.

Price **2s. 0d.** net.
Post Free **2s. 2d.**

THE

ELECTRIC TRAMCAR HANDBOOK,

For Motormen, Inspectors, and Depôt Workers.

By W. A. AGNEW.

CONTENTS: The Electric Circuit—Electric Tramways—Electric Tramcars—Controllers—Brakes—On the Road—Faults and Breakdowns—Index.

What the Press says:

"There is no doubt that a careful study of it, by such tramway employés, would result in a considerable saving in current and repairs and maintenance accounts of most tramway undertakings. . . . The Handbook seems very reliable and generally free from printers' errors."—**Electrician.**

"Can certainly advise all traction employés who are desirous of keeping themselves well informed with regard to all improvements in traction plant to purchase a copy of the book forthwith."—**Electricity.**

"One can express nothing but unqualified praise for the simple way in which the author has treated what is, after all, a somewhat complicated subject. . . . The Handbook is in many ways an excellent production, and one that should be on the bookshelf of every motorman in the Kingdom."—**Electrical Industries.**

"Provides a clear and practical exposition, in simple language, of the mechanism of the tramcar, from the standpoint of the man who has to drive it."—**Railway Gazette.**

H. ALABASTER, GATEHOUSE & KEMPE,

4, LUDGATE HILL, LONDON, E.C. 4

ELECTRIC SUPPLIES FOR AFTER THE WAR.

BAXTER & CAUNTER, Ltd.,

Beg to announce that with the co-operation of the various firms, for whom they act as agents, viz.:

NEWTONS, Ltd., ***DYNAMOS & MOTORS,***

LIVERPOOL ELECTRIC CABLE Co., Ltd.,
WIRES & CABLES,

CREDENDA CONDUITS Co., Ltd.,
CONDUITS, COOKING & HEATING,

RECORD ELECTRICAL Co., Ltd.,
MEASURING INSTRUMENTS,

they are now in a position to give early deliveries of material. The experience gained during the past four years, and the large extensions made in their own and the above-mentioned works, enable them to considerably increase the volume of their pre-war business now that the termination of the war relieves them of the manufacturing of munitions for the British and Allied Governments.

BAXTER & CAUNTER, LTD.,

Manufacturing, Mechanical, & Electrical Engineers,

219, TOTTENHAM COURT ROAD, W. 1,

AND

THALIA WORKS, GROSVENOR ROAD, HANWELL, W.

TELEPHONES: MUSEUM 2820 (3 Lines). MUSEUM 980 (Orders Only).

TELEGRAMS: RAPIDOLITE—OX, LONDON.

TELEPHONE (WORKS): EALING, 1209.

CONTRACTORS TO H.M. AND ALLIED GOVERNMENTS.

The "Electrical Review's" Suggestions

For dealing with

APPARENT DEATH FROM ELECTRIC SHOCK

should be in every Generating, Transforming and Motor House.

Chromo Art Paper, **3d.** each. Post Free **4d.**
Mounted on Linen and Rollers, **1s. 6d.** Post Free **1s. 9d.**
Mounted on Cardboard, **2s.** each. Post Free **2s. 6d.**
Reproduced on Galvanised Iron, price on application.

THE WIRELESS OPERATORS' POCKETBOOK OF INFORMATION AND DIAGRAMS.

By LEON W. BISHOP.

Cloth **4s. 6d.** net. Post Free **4s. 9d.**

Limp Cloth, cut flush. 48 Pages. 25 Illustrations, including 10 Photo-engravings. Super Royal 8vo.

Price **2s. 6d.** net. Post Free **2s. 8d.**

GRAPHS IN A CABLE-SHIP DRUM-ROOM:

NOTES FOR JUNIOR ASSISTANTS.

By EDWARD RAYMOND-BARKER,

Author of

"Handbook in Cable-break Localisation; Graphic Methods; the Calculator Board in Practice."
"Cable-fault Localisation Graphs in Practice."

Reprints of Articles published in "THE ELECTRICAL REVIEW," January 17th, 1913, *et seq.* With additional matter.

HANDBOOK IN CABLE-BREAK LOCALISATION.

Graphic Methods. The Calculator Board in Practice.

By EDWARD RAYMOND-BARKER, M.I.E.E.

Demy 8vo, 68 Pages, 38 Illustrations.

Paper Covers **1s. 6d.**, Post Free. Limp Cloth **2s.**

CABLE-FAULT LOCALISATION GRAPHS IN PRACTICE.

By EDWARD RAYMOND-BARKER, M.I.E.E.

24 Illustrations.

A Companion Volume to Handbook in Cable-Break Localisation (Graphic Methods, The Calculator Board in Practice), by the same author.

Paper Cover **1s. 6d.** Cloth **2s.**, Post Free.

THE COMMERCIAL ENGINEER'S POCKET BOOK.

ELECTRICITY SUPPLY.

A Handbook for Publicity Department Managers, Electricity Supply and Contractors' Representatives.

By FRANCIS H. DAVIES, A.M.I.E.E.

Second Edition, Revised and Enlarged. Limp Cloth, cut flush, round corners, red edges, demy 12mo, suitable for pocket (size 6¾ × 3¾).

Price **2s.** net. Post Free **2s. 1d.**

COMPUTING THE SPEED OF RECEIVING A TELEGRAPHIC MESSAGE.

Sent by Hand-Key or Automatic Transmitter.

By J. RYMER-JONES, M.I.E.E.

Price **4s.** net.

The method determines the *actual* number of *signal* and *spacing* elements received per minute, and excludes any abnormal spacing between words, or groups of numerals, the presence of which affects the time factor in the formula. The speed can therefore be correctly evaluated in terms of (say) 5, 7, or 10-letter words per minute by using their respective *speed constants* as the denominator; or else in "standard words" for *universal* comparison, by employing a recognised number of elements per 5-letter word.

Illustrated by practical examples obtained with the syphon recorder and Morse recorder.

The treatise contains, among other data, a comparison between the speed efficiency of the *International* and *American* codes.

Price **1/-**, Post Free **1/1.** Demy 4to, Paper Cover.

LOCALISING HIGH-RESISTANCE BREAKS IN CABLES.

By J. RYMER-JONES.

Reprinted from the "Electrical Review."

THE ELECTRICAL IGNITION OF PETROL ENGINES.

By J. W. WARR, A.M.I.E.E.

60 Illustrations.

An invaluable Book for the Motorist and Motor Cyclist.

2s. 6d. net. Post Free **2s. 8d.**

H. ALABASTER, GATEHOUSE & KEMPE,

4, Ludgate Hill, London, E.C. 4

M·E·M

The QUALITY products

Judged by comparison with other lines, "M.E.M." Switch and Fuse Gear will be found far superior in quality, convenience, efficiency and safety.

B 2171

It will also be noted how this is due to an unrivalled SIMPLICITY IN DESIGN—which minimises production costs as well, and thus ensures LOW PRICE.

D 1130

Our "M.E.M." range comprises many essential fitments for Engineering, Commercial, Ship and Dockyard, Power and Lighting requirements.

POINTS TO COMPARE in the "M.E.M." System:

Standardised and Interchangeable Units; Best-class English Porcelain Bases; Extra Strong Contact Blocks, easily renewable; Contacts undamageable by quick closing; Patent Arcing Chamber of utmost capacity; amply ventilated; Fewest connections, readily accessible; Live parts amply protected, &c.

May we fully describe our system to you?

The Midland Electric Mfg. Co., Ltd.,

BARFORD STREET, BIRMINGHAM.

Telephone: Midland 671 & 672 Telegrams: "Kilowatt, Birmingham."

BRANCHES:

LONDON: 2, Gresham Buildings, Basinghall Street, E.C.
'Phone: London Wall 723.
'Grams: "Tribord, London."

NEWCASTLE-ON-TYNE: Millburn House.
'Phone: Central 2524.

GLASGOW: 40, West Campbell Street.
'Phone: Central 4187 & 4188.
'Grams: "Cathode, Glasgow."

MANCHESTER: 4, Carr St., Blackfriars.
'Phone: City 1391.
'Grams: "Conduits, Manchester."

R.M.S. 1

"SUPREMELY SIMPLE AND EFFICIENT"

UNIVERSAL SUPPLIES, SWITCHGEAR, &c.

MOTORS, A.C. & D.C. STARTERS, &c.

LAMPS, Metal Filament and Half-Watt.

UNDERWOOD (Manchester), LTD.,
53, Brown Street,
'Phone: 5613 CITY.
'Grams: "GLEAMING," MCR.
MANCHESTER.

Pope's Dictionary Series No. 4.

Superior

Higher in place, rank, or excellence.
Surpassing others.
Pope *"Elasta"* Drawn Wire Lamps.

Licensed under British Patents Nos. 21513/06, 23499/09 and others.

Pope's Electric Lamp Co., Ltd.,
Hythe Road, Willesden, N.W. 10.

West End Depot: 5, Arthur St., New Oxford St., W.C. 1.
Liverpool Depot: 21, Manesty's Lane.

Telephone:—Central 4703. Telegrams: "Seejasir," Fleet, London.

THE
CONTRACT JOURNAL

ESTABLISHED 1879,

IS **THE PAPER** FOR

CONTRACTS OPEN,
RESULT OF TENDERS,
BUSINESS NOTES, &c.

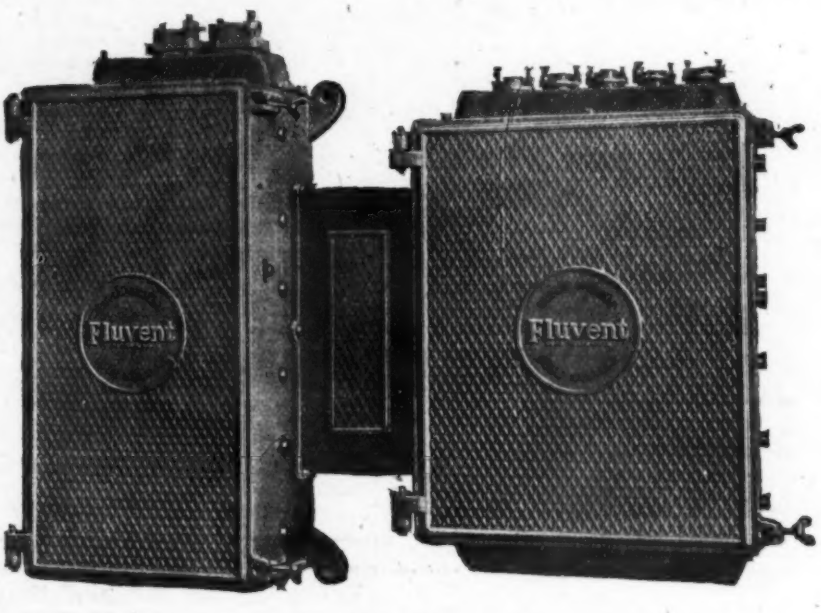
Specimen Copy 6d. Annual Subscription 26s.

ADVERTISEMENT RATES on application to Mr. PITMAN,
127/130, TEMPLE CHAMBERS, TEMPLE AVENUE, LONDON, E.C. 4

The "ELECTRICAL REVIEW'S" SUGGESTIONS
for dealing with
APPARENT DEATH
from Electric Shock should be in every Generating, Transforming and Motor House.
Mounted on cardboard, 2s. each, post free 2s. 6d.
Mounted on linen, and rollers, 1s. 6d. each, post free 1s. 9d.
4, LUDGATE HILL, LONDON, E.C. 4.

"Any combination arranged for ways of different capacity."

HOPE'S Patent "FLUVENT" Fuse system provides many conveniences. One is that any two "FLUVENT" Boards can be combined in a single unit where necessary to share fuse-ways of over 100 amp. in the same Board with ways of greater capacity—or where desirable to have a Board with a larger number of ways than the largest single-way size.



A 5-way 100-amp. 3-phase Board, coupled to a 2-way 300-amp. size.

HOPE'S PATENT

Fluvent

REGD. TRADE MARK

CONNECTABLE FUSEBOARDS

for Double-Pole and Three-Phase Circuits, are joined by a junction trough which holds the main bus-bar connections. Special interchangeable deep troughs are made to simplify entry of heavy cables.

Our standard Trough serves as a sealing box for paper or bitumen cables, but where desired to seal separately we supply a box to bolt to the standard Board.

Let us submit fuller details of this and other "FLUVENT" features.

PARMITER, HOPE & SUGDEN, LTD.,
Hulme Electrical Works, MANCHESTER.

London Office: 25, Victoria Street, S.W. 1. Scotland: David Alexander, Mains St., Waterloo St., Glasgow.
Birmingham & Midlands: S. Thos. Pemberton & Co., 7, Church St., Colmore Row, Birmingham.

B.H.S.

DISPLAYED ADVERTISEMENTS

ADVERTISERS will please note that **NEW COPY and ALTERATIONS to Existing Advertisements** (with Blocks) should reach here not later than **SATURDAY MORNING.**

The ELECTRICAL REVIEW is the recognised Medium of the Electrical Trades, and has BY FAR THE LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

NOTICES RELATING TO PATENTS.

Latest Time for receiving 9.30 a.m. Thursday.

John E. Raworth,

Queen Anne's Chambers, 28, The Broadway, Westminster, S.W. 1. Chartered Patent Agent.

THE Proprietors of the Patent No. 17752 of 1912 for "Electric Hand Apparatus for producing Light" are desirous of entering into arrangements, by way of licence or otherwise, on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to HASELTINE, LAKE & Co., Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C. 2. 6450

PATENTS AND DESIGNS ACTS, 1907-1914.

MANUFACTURING SMALL ELECTRIC TRANSFORMERS.

THE PROPRIETORS of British Letters Patent No. 4090 of 1913 are prepared to sell the Patent or to license British Manufacturers to work under it. It relates to surrounding with softened insulating material under high pressure the two windings and the part of the carcase carrying them.

Address: BOULT, WADE & TENNANT, 111/112, Hatton Garden, London, E.C. 1. 3706

OFFICIAL NOTICES.

Latest Time for receiving 9.30 a.m. Thursday.

THE AABADA TRUST, LIMITED.

SPECIALISES in the Finance and Construction of Public Utility Works in all parts of the world.

Electrical and other inventions tested and reported upon by an expert technical staff.

Approved schemes placed on a sound commercial basis.

Correspondence invited.

C. S. COLTON, *Managing Director.*

General Offices: 61, St. James' Street, S.W.

'Phone: 5655 Regent. 3249

ELECTRIC HEATING AND COOKING APPLIANCES.

MR. A. G. ENOCK, Consulting Engineer, 12, Heathland Road, Stoke Newington, N., is expecting to fit up two houses with the latest improved appliances for Electric Heating, Electric Cooking, including ranges, boilers and table appliances, vacuum cleaning by electric motor from a central machine, and any other appliances intended to reduce labour and dirt in private houses to which electricity could be applied.

Manufacturers are invited to forward particulars. 6505

EDUCATIONAL NOTICES.

Latest time for receiving, 9.30 a.m. Thursday.

SUCCESSFUL CORRESPONDENCE COACHING GUARANTEED for

A.M.I.E.E., A.M.I.C.E., A.M.I.M.E.,

City and Guilds Exams., Matriculation, B.Sc. (Eng.), etc.

Ten Years of Successes.—Personal Enquiry Invited.

Up-to-date Courses to meet *your* particular needs in *any* branch of Electrical—D.C. or A.C., Civil or Mechanical Eng.

Special Courses in Practical Mathematics and Calculus.

ELASTIC PAYMENTS. STRICT PRIVACY. EXPERT ADVICE FREE.

A **"U.E.C."** COURSE will return you many times the outlay through the ADVANCEMENT SECURED professionally.

Apply *now* (saying what interests you) for the **"U.E.C."** No. 7 PROSPECTUS—FREE, to:—ADVISORY SECRETARY,

UNIVERSITY ENGINEERING COLLEGE, 3, St. Mark's Crescent, Regent's Park, London, N.W. 1—(No provincial branches.) 6939

F. WIGGINS & SONS.

MICA

Telephone: Avenue 2248

FOR INSULATION.

Largest Stock in the World.

102, 103 & 104, Minories, LONDON, E. 1.

HOOPER'S

Telegraph & India-Rubber Works, Ld.

31, LOMBARD ST., E.C.3. *(Established 1860.)* | MILLWALL DOCKS, **LONDON, E.14.**

PURE TAPE AND STRIP, &c., &c.,

HOOPER'S Vulcanised India-Rubber Cables for Electrical Work maintain the highest quality, and their durability has been proved.

Telegrams: LINEAR, London. Telephone: 1169 Avenue & 84 East.

THE

"ELECTRICAL REVIEW'S" SUGGESTIONS

for dealing with

APPARENT DEATH

from Electric Shock should be in every Generating, Transforming and Motor House.

Mounted on Cardboard, 2/- each. Postage 6d. extra.

H. ALABASTER, GATEHOUSE & KEMPE, 4, Ludgate Hill, London, E.C.4

SECOND EDITION, REVISED AND ENLARGED.

Price 2s. 0d. net. Post Free 2s. 1d. Limp cloth, cut flush, round corners, red edges, demy 12 mo, suitable for pocket (size 6¾ × 3¾).

THE COMMERCIAL ENGINEER'S POCKET BOOK.

ELECTRICITY SUPPLY.

A Handbook for Publicity Department Managers, Electricity Supply and Contractors' Representatives.

By FRANCIS H. DAVIES, A.M.I.E.E.

H. ALABASTER, GATEHOUSE & KEMPE, 4, Ludgate Hill, London, E.C. 4.

ALL
EVERSHED INSTRUMENTS

possess characteristic qualities which distinguish them from similar instruments of other makes. For example,

CELL TESTING VOLTMETERS

These instruments are specially constructed for hard service, and are fitted with undamageable pivots. They are of the Moving Coil type and are dead-beat in action. The case is acid and fume proof, and the instrument is easily held in the palm of the hand. The detachable barbed spikes enable rapid and effective contact to be made to any type of cell.

EVERSHED & VIGNOLES, Ltd.,
ACTON LANE WORKS, CHISWICK, LONDON, W. 4.
Telegrams—"Dorothea, Chisk, London." Telephone—Chiswick 1370.

If your motor has to be started frequently under heavy load by unskilled operators, and if you require it to be fully protected, you should specify an

E.A.C. INCHING STARTER.

This is a patented device which embodies all the features of ideal starting gear, some of which are—

- The releases are free to operate under all conditions, so that the motor cannot be started up too quickly or against an overload.
- The circuit can only be made or broken on a contactor switch fitted with magnetic blow-out and renewable sparking tips.
- There is no spring return or hold on coil on the starter lever, so that ample brush pressure can be allowed.
- The operation of inching can be performed as often as desired without any fear of damaging the starter.

For further particulars write for leaflet H.12/2.

WE CAN GIVE
IMMEDIATE DELIVERY
OF ALL TYPES OF STARTERS AND CONTROL PANELS.

THE ELECTRICAL APPARATUS Co., LTD

GLASGOW. 21, HOPE STREET. CENTRAL, 260.
BIRMINGHAM. CARLTON HOUSE, HIGH ST. CENTRAL, 7972.
HEAD OFFICE & WORKS:- VAUXHALL WORKS, SOUTH LAMBETH ROAD, LONDON, S.W.8.
Telephone:- BRIXTON, 2075. A.B.C. CODE, 5TH EDITION.
Telegrams- "EAPPARATUS LONDON."
MANCHESTER. PALATINE BUILDINGS, VICTORIA ST. CITY, 9088.
NEWCASTLE-ON-TYNE. 63, BLACKETT STREET. CITY, 685.

Do you install unprotected motors? —fuse a small

Century

Repulsion Start—Induction

SINGLE-PHASE MOTOR

(1/10 to 1/4 H.P.)

so as to protect it when carrying full load—and that fuse will usually be of ample capacity to enable it to successfully start full load.

¼ H.P. Motor Geared to an Air Compressor.

Manufactured only by

CENTURY ELECTRIC COMPANY,

19th Pine to Olive Streets, St. Louis, Mo., U.S.A.

A STOCK OF "CENTURY" MOTORS IS CARRIED IN LONDON BY—

The Sole British Agents—

SWEDISH GENERAL ELECTRIC, LTD.,

5, CHANCERY LANE, W.C. 2.

Sales Manager: R. A. MARPLES.

Telegrams: "Autosyncro, Westcent, London." Telephone: Holborn 1708.

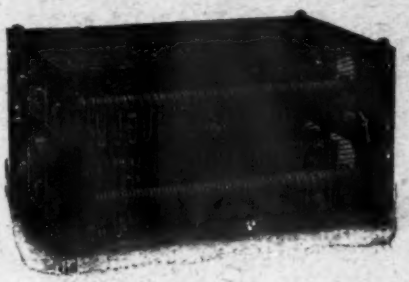
EMB EMB

EMB

RESISTANCES

Are guaranteed for 5 years

They are Unbreakable, Jointless, Rustless, Rigid and Non-inductive, and give permanent satisfaction.



Sole Makers

The Electro-Mechanical Brake Co., Ltd.,

West Bromwich, England.

Scotland - - A. F. Stevenson, 47, Waterloo St., Glasgow
Newcastle-on-Tyne F. H. Morley, Star Bldgs., Northumberland St.
Leeds - - - R. Haste Carr, Crown Point Road
Australia - - - J. G. Gilbert Lodge, Pitt St., Sydney

EMB EMB

REWINDING AND REPAIRS

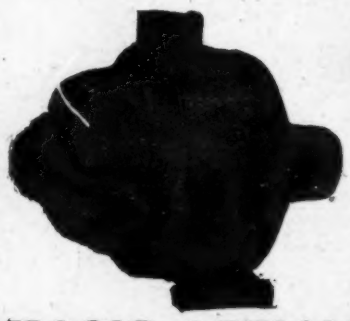
OF

MOTORS AND DYNAMOS,

FANS,

RHEOSTATS, &c.

VACUUM CLEANERS.



ALTERNATING AND DIRECT CURRENT.

MAGIC APPLIANCES, LTD., 159, Westminster Bridge Road, LONDON, S.E.1.

Telegrams: "Magicapco, Lamb, London." Telephone: Hop 4703.

SEND US YOUR ENQUIRIES

FOR

MOULDED INSULATING ARTICLES.

Our composition can be used as a substitute for Ebonite.

THE IMPROVED SOLIDITE CO., LD.,

10, CHARLTON PLACE,

Opposite Agricultural Hall,

ISLINGTON, N. 1.

Telephone: NORTH 1345.

DIMALITE

THE ONLY SUCCESSFUL "TURN-DOWN" ATTACHMENT FOR ELECTRIC LIGHT.

PAGE & SEYMOUR INC., 4, CHURCH ST., NEW YORK, U.S.A.

5 DIFFERENT CHANGES OF LIGHT!

SUPPLIED IN TWO TYPES: LOW VOLTAGE (80 to 130 V.) and HIGH VOLTAGE (200 to 250 V.).

BENJAMIN ELECTRIC, LTD., BRANTWOOD WORKS, TARIFF ROAD, NORTHUMBERLAND PARK, TOTTENHAM, N.17.

Telephone: MUSEUM 333.

TREDEGARS LTD

Wholesale & Export Electrical Supplies,

9, DIANA PLACE,
EUSTON ROAD, LONDON, N.W. 1.

Also at 47, Exchange Buildings, Birmingham.

We hold exceptionally Large Stocks of Everything Electrical.

A FEW OF OUR LEADING LINES ARE AS FOLLOWS:—

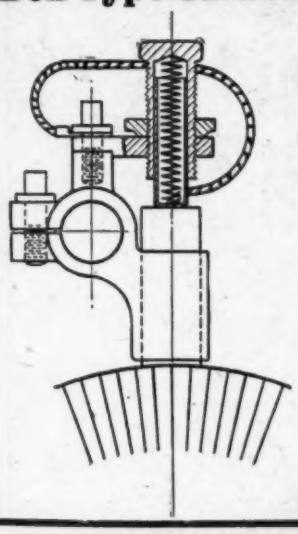
5,000 No. 2 Zinc Rods.
5,000 Dry Cells for Bells.
1,500 5-amp. P.B. Switches, on Cream Base.
1,500 5-amp. 2-way Switches, on Cream Base.
500 3-amp. P.B. Switches on Cream Base.
500 5-amp. P.B. Coupled Switches, unmounted.
2,500 Miniature S.C. Batten Holders.
1,500 Miniature C.G., S.C. Holders.
5,000 ⅜" S.C. Extra Heavy Type Holders.
1,500 Keyswitch Holders, C.G., S.C.
1,500 Keyswitch Holders, S.C., ½".
5,000 Jap. Batten Holders, S.C.
4,200 Walnut Adaptors.
2,100 Composition Adaptors.
3,000 6½" × 3½" Imitation Walnut Blocks.
100,000 1⅝" 2 and 3-wire Cleats.
90,000 2½" 2 and 3-wire Cleats.
1,500 9" Enamelled Iron Shades.
2,000 10" Enamelled Iron Shades.
500 12" Enamelled Iron Shades.
500 15" Enamelled Iron Shades.
10,000 2·5 and 3·5 Half Opal Bulbs.
40 Miles 3/22 N.A. Cable, 600 meg.
80 Miles 1/20 I.R., D.C.C1. Bell Wire.

Accessories List for January, 1919, Now Ready.

SAME WILL BE SENT ON RECEIPT OF POST CARD.

THE WESTMINSTER ENGINEERING CO., LTD.,
Victoria Road, Willesden Junction, N.W. 10.

Box Type Carbon Brush Holder



Over 10,000 supplied to Lighting and Power Companies for Commutators and Slip Rings.

Spring entirely enclosed.
Minimum circumferential space occupied.
Pressure in direct line immediately over centre of brush.
Substantially made and no screws or parts that can get loose.
Easy adjustment when running if necessary.

Can be made to suit any Machine. Recommended for Turbo Dynamos.

Telephones: 1700 WILLESDEN.
Telegrams: "REGENCY, PHONE, LONDON."

STAMPINGS

A.E. HARRIS & CO.
95, CAMDEN ST. BIRMINGHAM.
FOR ELECTRICAL TRADES

The MOLLER Patent Dust-Proof AIR FILTERS.
See Advertisement Dec. 6th.
FILM COOLING TOWERS, LTD., 124, Chancery Lane, London, W.C. 2

The Croft Granite, Brick & Concrete Co., Ltd.,
CROFT, near LEICESTER.
CROFT ADAMANT CELLWORK FOR E.H.T. EQUIPMENT.

URGENT REWINDING,
REPAIRS & RENEWALS.
Send to—
ELLERD-STYLES, 81, ROSEBERY AVENUE, E.C. 1.
'Phone: 1440 Central.

RALPH NEAL,
Maker of Presses, Press Tools & Punches
Of Every Description for Electrical and Mechanical Engineers.
BLANKS, WASHERS, PRESS PIERCINGS, DIE STAMPINGS IN STEEL, BRASS OR ANY MATERIAL FOR THE TRADE.
LABELS and NAME PLATES A SPECIALITY.
49 & 50, PERCIVAL ST., LONDON, E.C. 1
Telephone: 4946 Central.

DUGDELL'S PATENT MOVABLE FITTINGS.

Fig. 225

HUNDREDS OF PATTERNS.
Thousands of Repeat Orders.
See Full Page Second Issue of "Electrical Review" each month.
CATALOGUE ON APPLICATION.
FAILSWORTH, MANCHESTER.

WATER POWER PLANT.
JAMES GORDON & CO., Queen's House, Kingsway, W.C. 2.

SCREWS AND SMALL MACHINED PARTS.
THE ORMOND ENGINEERING CO.
(PROPRIETOR, E. J. DELFOSSE).
'Phone: Holborn 1812. 199, PENTONVILLE ROAD, LONDON, N. 1.

NAME PLATES
ENGRAVED CAST PRESSED PRINTED
BRASS COPPER ALUMINIUM IVORINE CELLULOID
LONDON LABEL CO LTD
HARLEY WORKS, BECKTON RD E

CAPPER PASS & SON, Ltd.,
BEDMINSTER SMELTING WORKS, BRISTOL.
Sellers of ANTIMONIAL LEAD of all Grades
BUYERS OF
LEAD ASHES & LEAD RESIDUES from ACCUMULATORS.
Telegrams: "PASS, BRISTOL." Telephone 3475.

LOWERING GEAR FOR ARC & METAL FILAMENT LAMPS ELECTROLIERS ETC
IN STOCK
THE LONDON ELECTRIC FIRM, ROYDON
IN STOCK
WINCHES FOR ARC LAMPS GENERAL LIFTING PURPOSES

Night Time Daylight.

THE Cooper Hewitt light is the nearest approach to daylight yet made. No flickering, no shadows. Send for Booklet No. 273, which contains detailed particulars of the Cooper Hewitt System of lighting.
THE WESTINGHOUSE COOPER HEWITT CO., LTD.,
80, York Road, King's Cross, London, N. 1.

Always Ready for Instant Use!

NEVER can you say that of stove or fire if you use either for Glue-heating—because of the preparation these out-of-date methods involve.
You will only reap the advantages which "instant readiness" here ensures when you commence with

"PREMIER"
ELECTRIC GLUE-POTS

—which are uniformly clean, need but a turn of the switch to bring regulated heat, minimise attention, are quicker—and all for an actual running cost of 2d. per 10-hour day.
Think what this means for maximum output—then write for prices.

PREMIER Electric Heaters, Ltd.,
258-260, Bradford Street, BIRMINGHAM.

'Phone: Midland 981.
'Grams: "Fahrenheit, Birmingham."

Which shall So to represent your Service?

EVERY lamp you supply or instal will reflect either credit or discredit on your ability as an electrical contractor.

Will you choose a wasteful lamp as the representative of your service to the consumer? Will it promote goodwill? Will it bring more business?

Or will you supply Mazda Drawn Wire Lamps, which ensure good and economical light and will give complete satisfaction?

You promote goodwill and good business every time you instal

MAZDA
DRAWN WIRE
Electric Lamps

Good Lighting.

- ¶ We are Specialists in Good Lighting.
- ¶ We design and make Scientific Lighting Appliances and Fittings as well as the Lamps.
- ¶ Lighting Advice and Plans on request.

MAZDA SALES COUNTER:

The Sales Counter at Mazda House is a model of convenience and good service. You haven't to climb stairs or wander fro n one department to another to collect your purchases. The Sales Counter collects them for you. It makes ONE job of ALL your requirements and saves you time and trouble.

THE BRITISH THOMSON-HOUSTON Co., Ltd.,
MAZDA HOUSE, 77, UPPER THAMES STREET, LONDON, E.C. 4.
Branches: Manchester, Birmingham, Leeds, Sheffield, Newcastle, Middlesbrough Glasgow, Swansea, Cardiff and Dublin. E. 107

Mazda House is the Home of Reliable Wiring Accessories.

Send us your enquiries for everything electrical you require.

If it's electrical- get it from B T-H

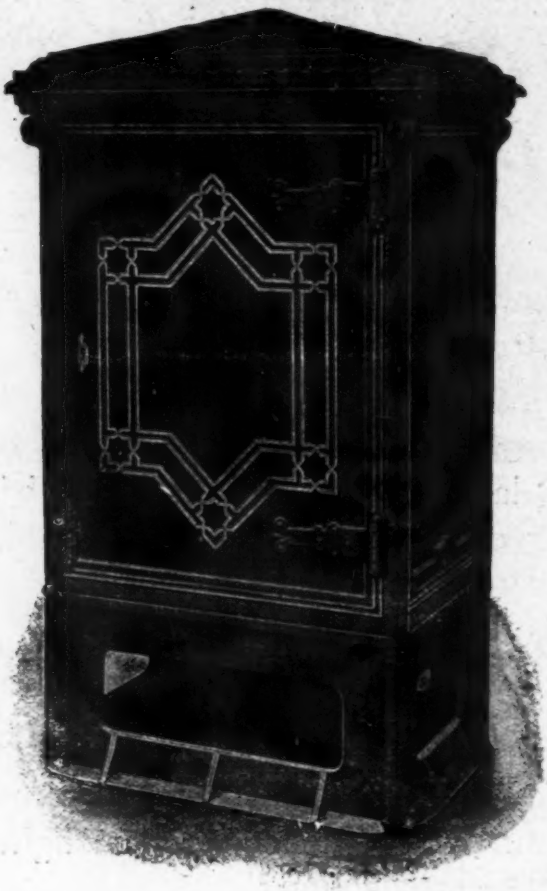
We are Specialists in Good Lighting. We design and make Scientific Lighting Appliances and Fittings as well as the Lamps. Lighting Advice and Plans on request.

Nat. Tel. No. 160 Worcester. Telegrams: "QUALITY" Worcester. Contractors to H.M. Government.
Established 1814.

FEEDER PILLARS.

N.B.

Please give us your Enquiries for odd sizes whether taller or shorter or



N.B.

with divided up interiors, &c., &c., also for doors and frames for brick chambers.

No. 1326 (Registered Design).

MADE IN SEVENTEEN STANDARD SIZES, BUT QUOTATIONS ALSO GIVEN FOR OTHER SIZES.

Makers of all kinds of TRANSFORMER PILLARS.

These Pillars are of very nice appearance, are thoroughly good castings, and are very efficiently ventilated. Each Pillar is provided with two doors, hung on massive ornate malleable iron hinges pivotted on ⅝ in dia. Brass Pins, and each door is fitted with a good Brass Lock. The first six sizes measure 4 ft. high overall above ground, the next 5 sizes, 4 ft. 3 ins. high, and size 5, 4 ft. 9 ins. high above ground. The underground part of all sizes is 1 ft. 3 ins. long.

Makers of all kinds of FEEDER PILLARS.

STANDARD SIZES:

	Inside Dimensions.	Clear Openings of Doors.
Size 1 ...	19 × 12 ins. ...	33 × 15 ins.
„ 1a ...	19 × 14 ins. ...	33 × 15 ins.
„ 1b ...	21 × 12 ins. ...	33 × 17 ins.
„ 2 ...	21 × 14 ins. ...	33 × 17 ins.
„ 2a ...	21 × 16 ins. ...	33 × 17 ins.
„ 2c ...	21 × 18 ins. ...	33 × 17 ins.
„ 2b ...	25 × 14 ins. ...	36 × 21 ins.
„ 3 ...	25 × 16 ins. ...	36 × 21 ins.
„ 3a ...	25 × 20 ins. ...	36 × 21 ins.
„ 3b ...	31 × 16 ins. ...	36 × 27 ins.
„ 4 ...	31 × 20 ins. ...	36 × 27 ins.
„ 5 ...	36 × 24 ins. ...	42 × 33 ins.
„ 6 ...	42 × 24 ins. ...	61 × 38 ins.
„ 7 ...	36 × 30 ins. ...	46 × 30 ins.
„ 8 ...	42 × 30 ins. ...	46 × 36 ins.
„ 9 ...	36 × 36 ins. ...	42 × 33 ins.
„ 10 ...	36 × 30 ins. ...	42 × 33 ins.

ARC LAMP PILLARS.

BRACKETS.

CARRIERS.

INCANDESCENT LAMP PILLARS.

CORONAS.

MANHOLES.

YOUR ENQUIRIES SOLICITED.

HARDY & PADMORE, LIMITED,

ONLY ADDRESS: WORCESTER, ENGLAND.

"A HAPPY NEW ERA."

A. REYROLLE & CO., LTD.,

HEBBURN-ON-TYNE.

Everything metal clad.

NO Accidental contact with live conductors.

BRITISH

Armoured Switchgear for **ALL** A.C. systems and voltages in

Power Stations,
Large and Small,

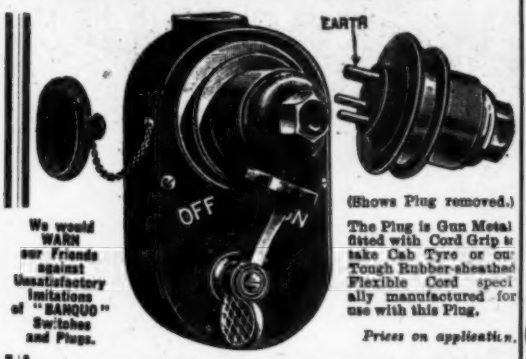
Substations,
Large and Small.

Mines and Consumers' Premises,
Large and Small.

Sound Switchgear saves Sleepless Nights.

"BANQUO"

"BANQUO" SAFETY INTERLOCKING COMBINED WATERPROOF SWITCH AND 3-PIN PLUG.



We would WARN our Friends against Unsatisfactory Imitations of "BANQUO" Switches and Plugs.

(Shows Plug removed.)

The Plug is Gun Metal fitted with Cord Grip to take Cab Tyre or our Tough Rubber-sheathed Flexible Cord specially manufactured for use with this Plug.

Prices on application.

"GUARDIAN"

PATENT HAND LAMPS.

TO COMPLY WITH H.O. REGULATIONS.

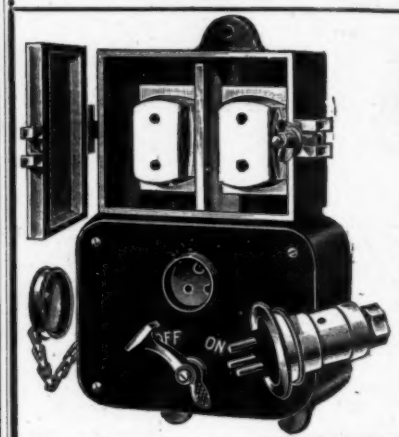
THE IDEAL MUNITION SHOP LAMPS.

ADOPTED BY THE LEADING ENGINEERING FIRMS, SHIPYARDS, CORPORATIONS AND GOVERNMENT DEPARTMENTS.

A feature of the "Guardian" Hand Lamp is the exceptional strength of the galvanized guard, which is manufactured from No. 8's iron wire. No Hand Lamp approaches the "Guardian" for safety, reliability and strength.

"GUARDIAN" (Type G1),
complete with heavy Guard and Lampholder.
PRICE 8/- each.

"CHALLENGE" (Type H.1).
Reliable H.O. Pattern Hand Lamp, complete with Galvanised Guard and Holder.
PRICE 5/- each.



"BANQUO"

Combined Interlocking D.P. Switch and Plug with D.P. Replacement Fuses.

Suitable to 250 volts.

This set comprises Double-Pole Switch which interlocks, with plug fitted with two pins and earthing pin.

"Izolex" Replacement Type Fuses are provided, and the whole enclosed in damp and dust-proof iron case.

Prices:

5 amps.	.. ..	£2 5s.
10 "	.. ..	£2 10s.
15 "	.. ..	£3 5s.

The plug has gun-metal cover, and will take our "T.R.S." Tough Rubber Sheathed flexible or ordinary Cab Tyre flexible.

DOCK AND FACTORY HEAVY CURRENT WATERTIGHT PLUGS.

As supplied to the War Office, and important Government, Railway and Dock Contracts.

Made in 2 or 3-pin plug type from 10 to 600 amps. capacity.

These plugs are substantially well-made. They are fitted with stout earthing connection, which make connection first and break connection last. A protecting cap is fitted with a chain which prevents the current-carrying parts from exposure when plug is out.

Ward & Goldstone

SALFORD — TRADE MARK — MANCHESTER

Telegrams: "Multum," Manchester.
Telephones: 7083-4-5-6 Central.

LONDON Offices: 59, New Oxford Street, W.C.1.
GLASGOW Office: 50, Wellington Street.

The "VOLEX" Switch.

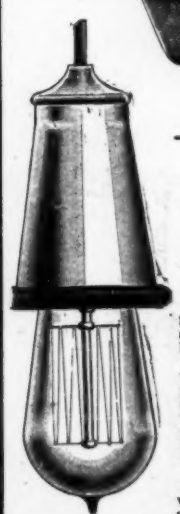
(Registered.)

As supplied in quantities under War Office, Railway and Dock Contracts.

New Pattern 15-amp. Type.

Superior finish of Design, Double Independent Break, Interlocking Lined Case, Watertight, Fool Proof.

Prices on application.



"SAMPSON"

Acid and Waterproof LAMPHOLDER.

Patent. Registered.

For use in Dye Works, Chemical Works, Steam Sheds, and exposed or corrosive positions.

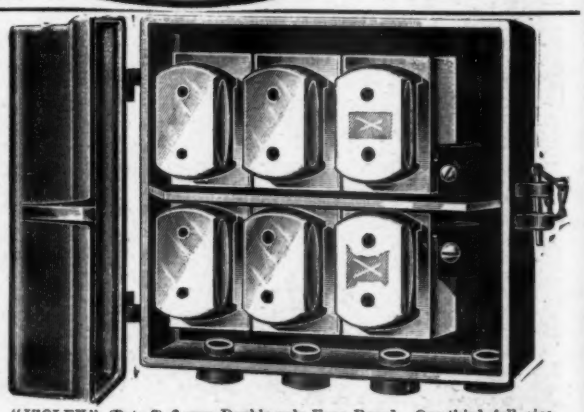
Specially designed to meet the demand for an acid and damp-resisting holder.

The shell is of strong vitreous acid-resisting porcelain fitted with an acid-proof rubber shield which effectively protects the lamp cap and interior lampholder from dampness and corrosion.

The top of the porcelain holder fits on loosely after wiring, enabling the top chamber of the interior to be filled with a sealing compound. The cap is then dropped back into position, when the sealing compound is plastic.

The features of this holder are ease in wiring, reliability, and effectiveness. The holder is arranged to take Standard Tough Rubber jacketted flexible Cord. (Prices and samples on application.)

List No. 101. Price 4/- ea.
Subject to trade discounts.



"IZOLEX" (Pat. 3) 3-way Double-pole Fuse Board. One-third full size.

THE "IZOLEX" REPLACEMENT FUSE BOARD.

PATENT APPLIED FOR. DESIGN REGISTERED.

"IZOLEX" Replacement Fuse Board in iron case with lined interior.

In the design of the case we have consulted the interests of the contractor, ample space being provided between the side of the case, ensuring the least possible trouble in fitting.

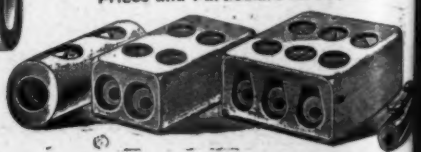
The Chiffa Bases are so raised that the wires can be carried below the fuses without difficulty, and the main cables are fitted in full view. "IZOLEX" Fuse Boards take the minimum of space, and are extremely neat and substantial in appearance. *"IZOLEX" Circular and prices on request.*

(Reg No. 382530.) **"INDISPENSO" CHINA CONNECTORS.** British Made.

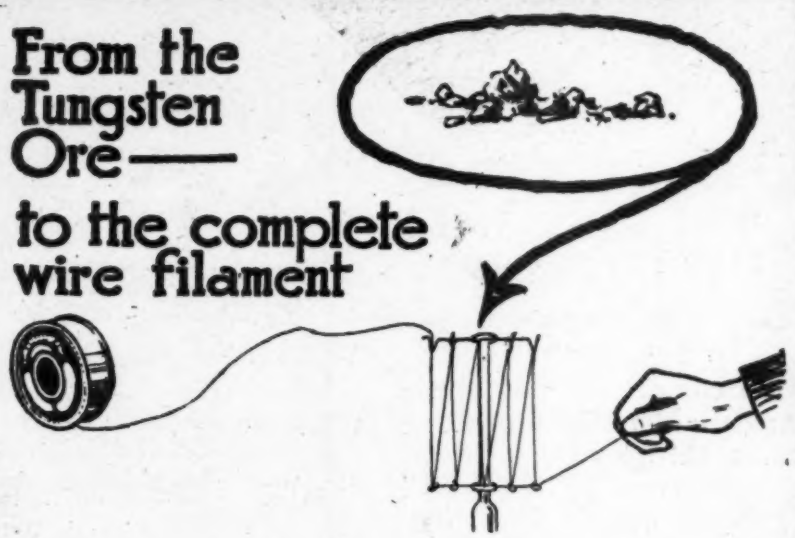
Substantial Metal Parts with good threads. No metal projecting parts.
Ensures good joints. Made in eight different sizes.

One, Two and Three-way, small size, to take up to 7/20's Cable (3·74 m/m).
One, Two and Three-way, medium size, to take up to 7/17's Cable (4·27 m/m).
One and Two-way, to take 19/17's (7·11 m/m).

Prices and Particulars on request.



From the Tungsten Ore—



to the complete wire filament

Process by process the work is carried out by British labour in our London Works. We do not buy the Tungsten Powder or the Tungsten Rod.

We begin with the Ore, refine and reduce it, work it into rod, swage it down, and finally draw down into the finest filaments.

We are Tungsten and Molybdenum experts.

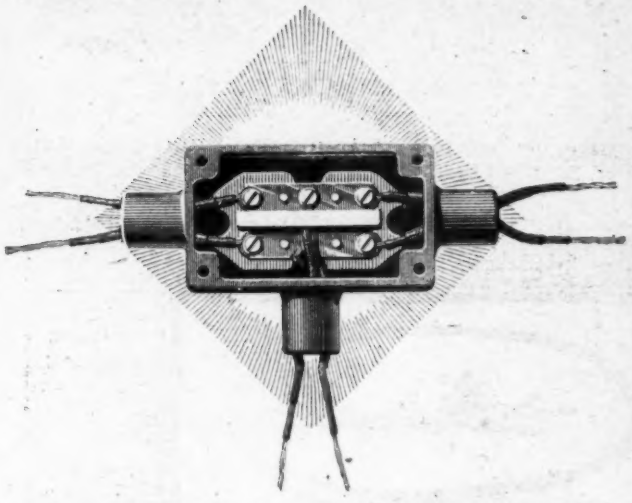
See that your lamps are made with

"Pladuram" Wire

which is the only sure guarantee of a British product from start to finish.

Duram Ltd

Thanet House,
231-2, Strand, London, W.C.2.



SIMPLEX CONDUIT WIRING

THE experiences of the war period have taught electrical and works engineers many things, the most important being the necessity of continuity of output; the maintenance of which depends upon their own foresight. The first consideration is the reliability of the electrical circuits, upon which everything else depends. This reliability can be assured by the use of Simplex Conduits, Fittings and Accessories. At times, the question of expense prevents the best being used, but in this case the question of expense does not arise, in that there is no system of Electrical Installation, taking both labour and material into consideration, which is less expensive than Simplex, and when freedom from after worry is considered, the Simplex System is far and away cheaper than any other. This desirable result is obtained by careful selection of material and dead interchangeability of all Simplex parts, which reduces labour costs to a minimum Every War Department during the period of national stress used Simplex. The war is won; and Simplex Conduits, Limited, are prepared for peace with larger works, better equipment and improved factory methods.

SIMPLEX CONDUITS, LTD.,

Works - Garrison Lane, Birmingham.

London: 113-17, Charing Cross Rd.
Bristol: 10-11, Denmark Street.
Glasgow: 72a, Waterlow Street.
Newcastle: 61, High Bridge.
Cardiff: 4, Westgate Street.
Leeds: 6, White Horse Street.
Liverpool: 96, Whitechapel.
Manchester: 16, Corporation St.
Sheffield: 281-3, Attercliffe Com.
Swansea: 14, Heathfield St.
Aberdeen: 1, Crimon Place.

BOOKS ON

ELECTRICAL ENGINEERING

PUBLISHED BY

SIR ISAAC PITMAN & SONS, LTD.

(Incorporating Whittaker & Co.),

1, Amen Corner, London, E.C. 4.

ELECTRIC LIGHTING AND POWER DISTRIBUTION. By W. PERREN MAYCOCK, M.I.E.E. An elementary manual of Electrical Engineering for students preparing for the Examinations of the City and Guilds of London Institute. SEVENTH EDITION.
Vol. I., 303 Illustrations. 7/6 net. Vol II., 407 Illustrations, 10/6 net.

ALTERNATING CURRENT WORK. By the same author. An introductory book for engineers and students. SECOND EDITION.
Cr. 8vo., 420 pp., 260 Illustrations, 7/6 net.

CONTINUOUS-CURRENT MOTORS AND CONTROL APPARATUS. By the same Author. An original and practical book for all classes of technical reader.
Cr. 8vo., 300 pp., 150 Illustrations, 7/6 net.

ELECTRIC WIRING, FITTINGS, SWITCHES AND LAMPS. By the same Author. A practical book for electric light engineers and contractors, consulting engineers, architects, builders, wiremen and students. FIFTH EDITION, REVISED.
Cr. 8vo., 638 pp., 620 Illustrations, 9/- net.

ELECTRIC CIRCUIT THEORY AND CALCULATIONS. By the same Author. Explains the theoretical principles underlying arithmetical problems concerning electric circuits of all descriptions, and shows how such problems may be worked out. SECOND EDITION.
Cr. 8vo., 355 pp., 120 Diagrams, 6/- net.

INSULATION OF ELECTRIC MACHINES. By H. W. TURNER, M.I.E.E., and H. M. HOBART, M.I.C.E., M.I.E.E.
In Demy 8vo., cloth gilt, 297 pp., with 102 Illustrations, 15/- net.

MAGNETO AND ELECTRIC IGNITION. By W. HIBBERT, A.M.I.E.E.
New edition containing a chapter on "Recent Developments."
Pocket size, with 95 Illustrations, 3/- net.

DIRECT-CURRENT ELECTRICAL ENGINEERING. By J. R. BARR, A.M.I.E.E. Treats specially with the main principles of Electrical Engineering.
In Med. 8vo., with 294 Illustrations, 12/- net.

Write for Catalogue which gives full particulars of the above books, post free on application.

RECONSTRUCTION

We have a well-equipped machine shop ready to commence on all kinds of

REPETITION WORK.

SMALL BRASS FITTINGS A SPECIALITY.

Send your inquiries and blue prints to

AEROPLANE GENERAL SUNDRIES, LTD.,
Fulwood House, Fulwood Place,
HIGH HOLBORN, W.C. 1.

Telegrams: "ZEPPISKOUT," HOLBORN, LONDON.
Telephone: *Office:* Holborn 4862. *Works:* " 2728.

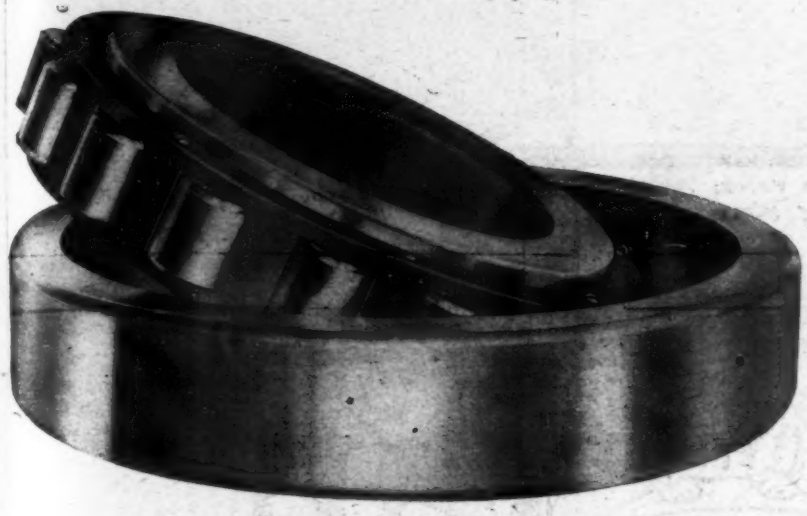
"HOBSIL" INSULATING BRICKS

GIVE HIGHEST EFFICIENCY FOR

ELECTRIC FURNACES, OVENS, &c., &c.

HOBDELL, WAY & CO., LTD.,
124/7, MINORIES, LONDON, E. 1.
Telephone: Avenue 3810.

HOFFMANN



ROLLER BEARINGS

BRITISH THROUGHOUT

PREDOMINANT

THE HOFFMANN MANUFACTURING CO., LTD., CHELMSFORD, ESSEX.

C. & C. TRANSFORMERS

"DIAMOND" TRANSFORMERS

Lighting Transformers, Power Transformers, Furnace Transformers, 2-Phase, 3-Phase Conversion Transformers, Boosting Transformers, Balancing Transformers, 3-Phase Earthing Transformers, Impedance Coils, Auto-Transformers, Wireless Transformers.

Sole Makers—

CLARKE & CLARKE,

Marlborough Works,

23, Nursery Road, Hockley, BIRMINGHAM.

Telephone: 136 Eastern.
Telegrams: "Cuivre, London."

66" COPPER EXPANSION PIECE.

EXHAUSTING TURBINE ENGINES.

HIGH-CONDUCTIVITY.

CASTINGS and COPPER FORGINGS

JOHN DORE & CO.,

Coppersmiths and Brass Founders,

BROMLEY, MIDDLESEX.

"BAMBER'S" NON-ENCRUSTING ZINCS

FOR PRIMARY BATTERIES

Are free from encrustation and local action.
Ensure a full and constant supply of current.
Have more than double the life of ordinary zincs.
Require little attention, with consequent low maintenance charges.

WRITE FOR PARTICULARS.

THE EYRE SMELTING CO., LTD.,

Merton Abbey, London, S.W.19.

Telegrams: "Analyzing, London." Telephone: Wimbledon 591.

PATENT LOUD SPEAKING WATERTIGHT TELEPHONES

AS ADOPTED BY
MANY FOREIGN GOVERNMENTS AND THE LEADING STEAMSHIP LINES.

Complete Installations for: *SHIPS, MINES, POWER STATIONS,* ETC.,

ON DIRECT INTERCOMMUNICATION OR
CENTRAL EXCHANGE SYSTEMS.

ALFRED GRAHAM & Co.

(Pioneers in Loud Speaking Telephony).

ELECTRICAL ENGINEERS AND CONTRACTORS,

Telephone: 959 SYDENHAM. *CROFTON PARK, S.E.* Telegrams: "NAVALHADA, LONDON."

The Best Xmas Box contains a Brook's Motor.

E. BROOK, LTD.

EMPRESS WORKS, HUDDERSFIELD.

Tel.: 1629-1630. Wires: "Phase."

ALSO AT

11, QUEEN VICTORIA STREET, LONDON, E.C. 4.

Tel.: 4468 City. Wires: "Phasebroo, Phone, London."

AND

49, BASINGHALL STREET, LEEDS.

Tel.: 23396.

The Electrical Equipment that will pay best during and after reconstruction is that which combines

ABSOLUTE SAFETY,

MAXIMUM EFFICIENCY,

REASONABLE COST.

This Combination is best secured by the use of **"SAFUSE"** and **"DONLOK"** **Switch, Fuse and Plug Gear.**

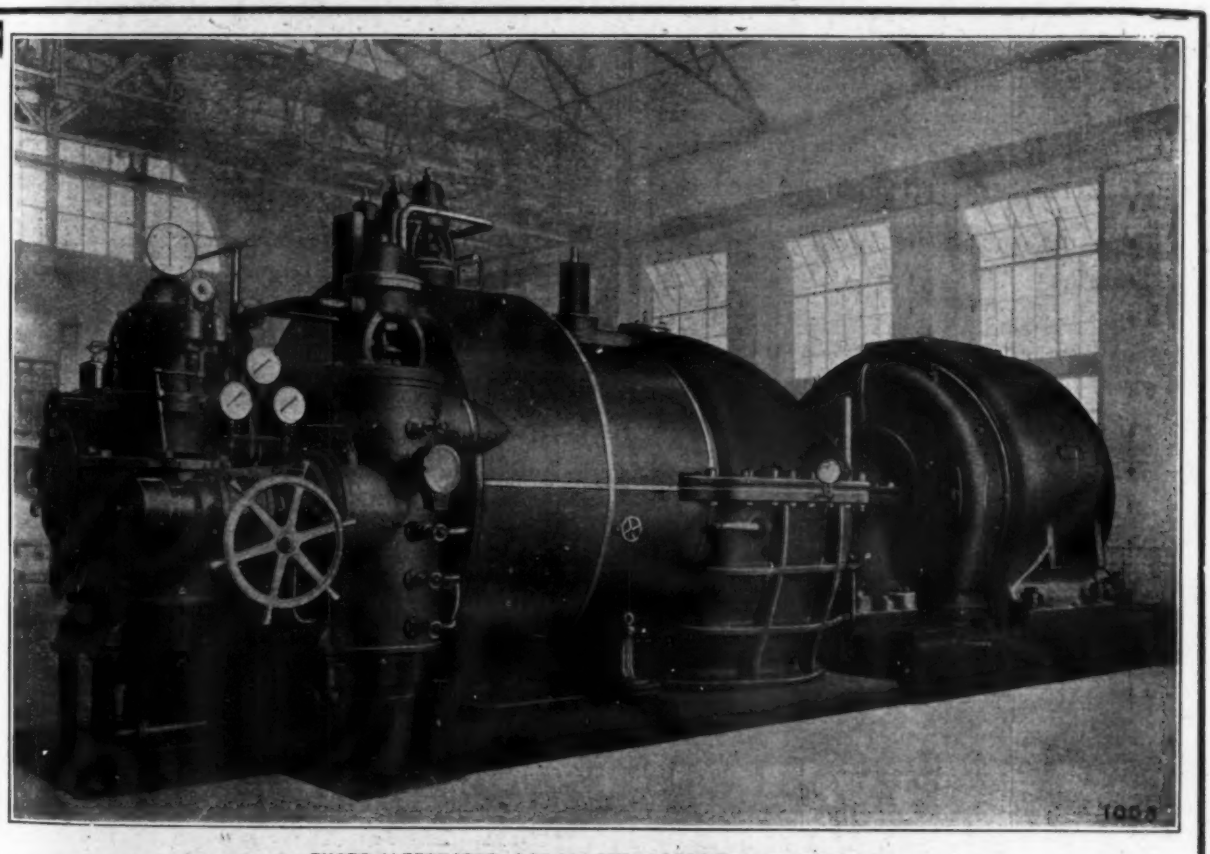
Sole Manufacturers and Patentees:—

DONOVAN & CO.,

47, Cornwall Street,

BIRMINGHAM.

Telegrams: "Donovan," Birmingham.



TURBO-ALTERNATOR of 20,000 KW. at 1,500 Revs. per minute.

STEAM TURBINES (with or without Condensing Plants) coupled to Alternators or Dynamos can be delivered relatively **QUICKLY.**

BROWN-BOVERI & CO., LTD.,

9, Old Queen Street, WESTMINSTER.

CONTROL
IGRANIC
ELECTRIC
DEVICES

No. 25.—Heavy Duty Starter.

Manually Operated Starting Switches for . Every Application .

"Igranic" hand-operated starting switches are the fruit of over 20 years' experience in this particular field.

In that time the engineers who have designed them have been presented with problems more diverse than can have been encountered by anyone who has not so specialised.

Their experience embraces practically every duty to which electric motors have hitherto been applied, as well as many projects likely to materialise in the future.

The result is a range of types which, for diversity and utility, is unsurpassed.

To those not continually studying this particular subject, it is often difficult to select the most suitable type for an individual job, from so large a variety.

"Igranic" engineers are always ready to advise and devise solutions for unusual problems.

No. 510.—Self-acting Starter-Regulator.

Automatic Starters for Push Button and . Remote Control .

The first self-acting motor starting switches were "Igranic" productions.

That was many years ago and those early examples marked a notable advance in the art.

But they were crude by comparison with the "Igranic" self-acting starters of which so many thousands are now in use.

The relative perfection of to-day was not attained at the first attempt. Difficulties not originally anticipated had to be faced and overcome.

Patent research, the knowledge gained by long experience and practice, and the pooling of ideas by a corps of experts concentrating on this one subject, have produced a standardised line of self-acting starters which have withstood, and are daily bearing the brunt of actual working conditions in hundreds of industries, all over the world.

IGRANIC ELECTRIC Co LTD

147, Queen Victoria Street, LONDON.

30, Cross Street, MANCHESTER.

Works: BEDFORD.

50, Wellington Street, GLASGOW.

Printed by WILLIAM CATE, LTD., 147-150, Saffron Hill, E.C. 1, and Published by the Proprietors, H. ALABASTER, GATEHOUSE & KEMPE, 4, Ludgate Hill London, E.C. 4.

Book Notice.—"B.E.A.M.A. *Journal*" (Spanish Edition). Vol. II, No. 4. December, 1918. London: Oakley House, Bloomsbury, W.C.

Liquidation.—Switchgear Construction Co., Ltd., Park Street, Southwark. Application for release of trustee, Mr. J. H. Stephens. Last day for objections, December 28th.

LIGHTING AND POWER NOTES.

Argentina.—Strike.—The employés of the German Trans-Atlantic Electricity Co., who had been on strike for about two months, returned to work at the end of October, on the terms of settlement offered by the company.

E.L. Scheme.—The Municipality of Federacion (Entre Rios) is considering the question of installing an E.L. scheme in the town. —*Review of the River Plate.*

Aylesbury.—Proposed Extensions.—The U.D.C. has decided to apply to the Ministry of Munitions for permission to extend the electricity works, and to offer a supply to Nestlé's and Anglo-Swiss Milk Co. as a stand-by, at 6·6d. per unit for lighting and 2d. per unit for power, with a minimum payment of £120 a year.

Bristol.—Proposed Loan.—The T.C. has decided to apply for a loan of £88,000 for extensions in connection with the electricity department during the next three years; the sum includes £50,000 for mains, £9,000 for house services, and £29,000 for sub-stations.

National Electricity Supply.—On the recommendation of the general manager, Mr. H. Faraday Proctor, on Friday last, the Electricity Committee resolved that the report of the Incorporated Municipal Association on the question of Electric Power Supply, should be approved, with the exception of that portion of Paragraph 2 which dealt with the constitution of the District Boards; the Committee expressed the opinion that where companies were now operating, and continued to operate as either generating or distributing authorities, they should not be excluded from representation on such Boards.

Continental.—Sweden.—Among the new companies formed to establish electric generating or distributing stations, are the Gammelsbyns Kraft Aktiebolag, Langvikamon; the Ostavalls Elektriska Aktiebolag, Ostavall; and the Langeds Elektriska Aktiebolag, Nordmaling.

Spain.—The Government has granted a concession for the establishment of a plant to utilise the water power of the River Restabal, near the town of that name, in the Province of Granada, for the generation of electricity.

Don José Cardona Palos has been authorised to utilise 7,600 litres of water per second from the River Mijares, Province of Castellon, for the generation of electricity.

Don Alfredo Velasco y Sotillo has been authorised to utilise 700 litres of water per second from the River Durcal, Province of Castellon, for the production of electricity.

With the title of Energia e Industrias Aragonesas, S.A., a company has been formed in Barcelona with the object of developing several waterfalls in the Valley of Tena, Province of Huesca, and the construction of a factory for chemical products and their derivatives is to be undertaken. The capital of the concern is 3,000,000 pesetas.—*La Energia Electrica.*

Austria.—The first installation to use the water power of the Danube for generating electrical energy on a large scale is to be erected 15 km. below the junction with the Enns, to the north-east of Mitterskirchen. The fall will be 7·6 to 13·45 m., and 17 units will be installed with an output of 52,000 to 125,000 kw., according to the level of the water. A company, in which the Austrian Siemens-Schuckert Works will have the most important interest, is to be formed to erect and run the generating station. Part of the output will be taken by Vienna.—*Elektrotechnische Zeitschrift.*

Dublin.—Coal Shortage.—At a meeting of the Corporation last week, Alderman Farrell called attention to the serious position of the coal supply in Dublin. The Coal Controller had done his best in the matter, but had failed to get coal. The engineer had been instructed to purchase coal at £3 per ton whenever he could get it, but it would eventually work out at nearly £10 per ton.

Edinburgh.—E.L. Charges.—The T.C. has decided not to adopt the increased charges for electricity recommended by the E.L. Committee. Members in favour of the increase argued that it would be improper to meet the increased charge, with which the department is faced, out of the reserve fund, which now stands at over £99,000, while the objectors contended that users of power should have some consideration when changing over from munitions to ordinary work. The charges proposed were 4d. per unit for lighting and 1½d. per unit for power, increases of ½d. and ½d. respectively.

Hebburn.—Street Lighting.—The U.D.C. has provisionally agreed to a scheme of the Northern Counties E.S. Co. for renewing the public lighting system; the company is to bear the cost of relaying the mains and renewing the lamps, estimated at £3,986, and the Council is to supply new posts, estimated at £5,832.

Isle of Wight.—Street Lighting.—The Isle of Wight E.L. Co. is to light half the street lamps at Sandown, at £110 per quarter, and half the lamps at Ventnor, at £420 per annum.

London.—Kensington.—Price Increase.—The B.C. is opposing the application of the Brompton and Kensington E.S. Co. for powers to increase its charges from 13s. 4d. for any quantity up to 20 units per quarter, and 8d. per unit over 20, to 16s. 8d. up to 20 units, and 10d. per unit beyond that amount.

Shoreditch.—Year's Working.—There was a net profit of £6,006 on the working of the B.C. electricity department for the year ended March 31st, 1918.

St. Pancras.—The Electricity Committee has applied to the Ministry of Munitions for permission to complete the extensions to the boiler house and generating plant at the King's Road station.

East London.—The Poplar and West Ham Borough Councils have decided to obtain an independent report on the question of an electricity supply scheme for the eastern districts, in view of the proposed centralisation of supply.

Lynn.—Proposed Extensions.—At a meeting of the T.C., the engineer reported that in order to supply electricity to the two shipyards which were being built at West Lynn, extensions costing £7,500 would be required at the electricity works, and the cost of the necessary mains was estimated at £3,000. Subject to consent to the extensions being obtained, energy is to be offered to the firms in question at £4 10s. per kw. of maximum demand per annum, plus 1½d. per unit, with a variation of ·03d. for every 1s. increase or decrease in the price of coal.

Morocco.—A company, with a capital of 2,500,000 pesetas, has obtained a concession to erect two generating stations for the supply of electricity to Fez. An installation has already been established in the district for the driving of flour mills, and the Sultan possesses workshops equipped with four turbines, which derive energy from the Fez River. There are many rivers in Morocco capable of yielding 30,000 h.p. each.—*La Energia Electrica.*

Slaithwaite.—Prov. Order.—The U.D.C. has appointed a deputation to meet the Huddersfield T.C., which is applying for an E.L. prov. order for the district.

South Africa.—Cape Town.—Price Increase.—The Electricity Committee has recommended that the 10 per cent. war charge authorised by the Council on November 29th, 1917, for supplies of electricity be extended to cover all tariffs, with the exception of those under contract, which it is proposed to deal with on their merits as the contracts mature.

Owing to the defective condition of the boiler at the air-compressing station, it is intended to drive the compressor by electric power, and the City Council has authorised the expenditure of £1,400 for this purpose.

Southend-on-Sea.—Proposed Extensions.—The T.C. has decided to lay additional mains to the Thorpe Bay area, instead of proceeding with the scheme for the erection of a new sub-station.

The electrical engineer has been authorised to negotiate with the firms from which the additional plant for the central station and the Leigh-on-Sea sub-station was ordered, with a view to obtaining the same.

South Shields.—Year's Working.—There was a net deficit of £3,849 on the working of the Corporation electricity department for the year ended March 31st, 1918, compared with £2,941 in the preceding year. The income amounted to £35,185, against £32,370, and the working expenses increased from £18,829 to £21,874. Capital charges increased from £15,236 to £16,108. 5,413,980 units were sold, against 4,921,944, and included—lighting, 900,650, against 858,619; heating, 232,263, against 184,265; power, 2,855,394, against 2,616,713; public lighting, 30,168, against 13,769; traction, 1,385,505, against 1,248,578. The works cost per unit was ·954d., against ·909d., and the total cost, 1·559d., against 1·578d. Up to the end of the financial year the pre-war charges for electricity had not been increased. The electrical engineer estimates that had permission been obtained to install a new water-tube boiler in March, 1917, a saving of £1,000 in fuel and labour could have been effected during the year. The maximum demand was 2,684 kw., and the load factor 23 per cent.

Stoke-on-Trent.—Fire.—A fire, causing considerable damage, occurred on Thursday, last week, in a storeroom at the Hanley electricity works, but was extinguished in about an hour.

Twickenham.—Fire.—Damage was done to the stores at the electricity works last week by a fire, which was fortunately extinguished before it reached the engine room.

Uruguay.—E.L. Scheme.—The Municipality of Cruz del Eje (Cordoba) is installing an E.L. scheme, and supply is to commence in January next.—*Review of the River Plate.*

Walton-on-Thames.—Mains Extension.—The U.D.C. is considering an application by the Urban E.S. Co. for permission to lay a h.t. cable from Esher to Thistlecroft, Hersham.

Whitby.—Price Increase.—The U.D.C. has adopted the following revised charges for electricity:—Lighting, flat rate, first 500 units per quarter, 6d. per unit; second 500, 5d.; beyond, 4d.; outside lighting, flat rate, 4d.; long-hour consumers, maximum demand rate, exceeding 150 units per quarter, first 1½ hours in winter and first half-hour in summer, 6d.; remainder, 4d.—discount of 5 per cent.; contract demand system, £3 15s. per quarter per kw. demand, plus 1½d. per unit; heating and cooking, first 60 units per quarter, 2½d.; beyond, 1½d.; contract demand system, 5s. per quarter per kw. demand, plus 1½d. per unit; flat rate for power, 25 per cent. added to existing rates.

Wimbledon.—Year's Working.—For the year ended March 31st last, the income of the B.C. electricity department was £50,211, against £41,988 in the previous year. The working expenses amounted to £31,306, against £27,587, and after paying capital charges amounting to £18,524, the net profit was £380. The generation cost was 1·509d. per unit, against 1·269d., and the total cost, excluding capital charges, 2·015d., against 1·783d. 5,181,030 units, against 5,079,485, were generated, and 3,727,097, against 3,712,749, were sold; 288,068, against 315,208, were sold for public lighting; 1,347,744, against 1,396,358, for private lighting; and 2,091,285, against 2,001,183, for power and heating. The average price obtained per unit was 3·144d., against 2·647d. The total capacity of the undertaking is 4,825 kw., and the maximum demand, 2,219 kw. The capital expenditure was £272,490, and the reserve fund £12,500.

Wolverhampton.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £1,000, for the provision of sub-station equipment.

The scheme for providing an overhead runway with tubes for the removal of ashes from the old boiler house at the electricity works, at a cost of £423, has been approved.

Woking.—E.L. Charges.—The E.S. Co. has withdrawn its application for powers to increase the maximum price of electricity.

TRAMWAY AND RAILWAY NOTES.

Australia.—A delegation of three officials of the Victorian Railway Department has been appointed to visit America "to secure the information necessary to enable an electric furnace to be installed at the Newport workshops for the production of high-grade castings." They will also study the application of electricity to portable tools, and electric welding.

Continental.—Electrification of Dutch Railways.—An important lecture was delivered recently by Geesteramus in the Koninkijk Instituut van Ingenieur on the advantages of the electrification of railways, and containing a description of the operation of the South Dutch electric railway between Rotterdam, Haag, and Scheveningen, which is intended to act as an example in future Dutch plans for the electrification of the railway system of the country. A change to the electrical system is planned on the sections Amsterdam—Haag—Rotterdam, Amsterdam—Hilversum, Amsterdam—Zaanstreek—Beverwijk—Haarlem (Ymuiden), Rotterdam—Maassluis.

Sweden.—Railway Electrification.—The Administration of the Swedish Railways has issued a report, which states that the plan for the electrification of the whole railway system is nearing completion; the work is estimated to take ten years to complete. It is also proposed to lay cables along the track for the supply of power for agricultural purposes.—*Financier.*

Spain.—The Empresa de los Tranvias de Granada, which has just inaugurated extensions from Atarfe to Elvira and Pinos Puente, proposes to construct other lines in the Provinces of Granada and Cadiz, the first to be taken in hand being that from San Fernando to Chiclana.

Don Carlos Lezcano y Fernandez, president of the Sindicato de Iniciativas de Guadarrama, has applied for a concession to construct an electric railway from Cercedilla to the port of Navacerrada.

Don Bibiano Gonzalez Saez has applied for concessions from the Ministry of Public Works for the extension of the Santander tramway system.

Leeds.—Track Renewals.—The Tramways Committee has obtained B. of T. sanction for 2,000 tons of rails for tramway track renewals; the tramway manager stated that about 10 miles of permanent way required renewing.

London.—Development Committee.—It is reported in the daily Press that tramway managers of Greater London propose forming themselves into a Committee to develop tramway services and to co-ordinate joint services.

Taunton.—Electric Vehicles.—The T.C. has decided to apply for L.G.B. sanction to a loan of £4,500 for the purchase of three electric vehicles.

United States.—Railway Electrification Recommended.—Electrification of the mountain divisions of the California railroads has been recommended to Director-General of Railways McAdoo by Mr. D. M. Folsom, director of the Pacific Coast section of the Oil Division of the Fuel Administration, as a means of conserving the use of fuel oil and reducing the total operating expenses of sections of the railroads involved by $4,923,300 a year. The investigations on which the report was based were made by Mr. W. F. Dietrich, engineer for the Pacific Coast Section of the Oil Division of the Fuel Administration, working under the direction of Mr. Folsom.

TELEGRAPH AND TELEPHONE NOTES.

Radio-Telephony.—The *Derby Despatch* states that American aeroplanes fighting in France up to the moment of the Armistice were manœuvered under the vocal orders of the squadron commander that reached each pilot by radio-telephone. News of the successful development of this device (hitherto a military secret) has been allowed to become public by Mr. John E. Ryan, Director of Aircraft Production. "I have myself," he declared in a statement, "standing on the ground, given orders to a squadron flying in the air, and watched them manœuvre accordingly. The transmission of the voice is clear enough to be heard distinctly through the sound of the aeroplane motor." The President of the Institution of Civil Engineers, in his presidential address a few weeks ago, hinted at important developments in this direction during the war.

South America.—The *Review of the River Plate* states that the Brazilian Government has authorised Mr. Frank Carney, representing the Central Telegraph Co., to form a company for the purpose of constructing and working a direct cable between Rio de Janeiro and Cuba.

Wireless and the Air Service.—As soon as the relaxation of restrictions allows of the free flight of aeroplanes, the air service will be greatly developed. A system of wireless, and a complete organisation for its effective use, will be features of the scheme making for increased safety. Mr. Godfrey Isaacs has made a statement to the daily Press that the Marconi Co. will be prepared to supply every aeroplane with a combined wireless and telegraph installation, under the management of a thoroughly qualified operator, adopting the system that is now in force with regard to ships. There will be charts and direction finders which will give the operator the exact position of the aeroplane wherever it may be. Wireless stations are to be erected on the frontier of Cashmere and the Chinese side of Siberia. Mr. Isaacs has arranged with Mr. Handley Page for the transport of the apparatus to the sites by big aeroplanes.

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—Sydney.—April 28th. City Council. Supply and erection of power house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.

Victorian Railways Department.—January 15th. Supply of battery cells. Particulars from Agent-General for Victoria, London, S.W.

Liverpool.—December 30th. B. of G. Electrical supplies for three months, for the Toxteth Park B. of G. Mr. R. A. James, Clerk, 15, High-Park Street.

Sheffield.—January 7th. Corporation Tramways and Motor Committee. 50 double-decked, top-covered, vestibule tramcar bodies with trucks. Mr. A. R. Fearnley, General Manager Division Street.

CLOSED.

Edinburgh.—Corporation E.L. Committee:—

New plant at Dewar Place Station, £28,703.—British Thomson-Houston Co., Ltd.

Government Contracts.—The undermentioned contracts were placed during November, 1918:—

War Office.

Chatterton's compound.—India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.
Dynamos.—Austin Motor Co.
Electric lighting sets.—Petters, Ltd.
Generating sets.—Aster Engineering Co.; R. A. Lister & Co., Ltd.
Motors, &c.—H. T. Boothroyd, Ltd.; Brown Bros.; City Electrical Co.; Crompton & Co., Ltd.; Electric Construction Co., Ltd.; Phœnix Dynamo Manufacturing Co., Ltd.
Alterations and additions to turbo-alternator plant.—General Electric Co., Ltd.
Insulating tape.—Chemical Engineering Corporation, Ltd.; J. G. Ingram and Son.
Transformers.—British Electric Transformer Co.; Foster Engineering Co., Ltd.
Electric trucks.—Electromobile (Leeds), Ltd.
Iron and steel wire.—F. A. Power & Sons.

General Post Office.

Telegraph apparatus.—India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.; Siemens Bros. & Co., Ltd.
Telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Western Electric Co., Ltd.
Telegraph and telephone cable.—London Electric Wire Co. & Smiths, Ltd.; C. Macintosh & Co., Ltd.; Union cable Co., Ltd.
Telephone cords.—British Insulated & Helsby Cable, Ltd.; Peel-Conner Telephone Works, Ltd.
Rearrangement of motors, gears, &c., on electric lifts at Money Order Office, Holloway.—Medway's Safety Lift Co.
Cable between Grimsby and Immingham Telephone Exchanges.—W. T. Henley's Telegraph Works Co., Ltd.
Bronze wire.—British Insulated & Helsby Cables, Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.).
Bronze insulated wire.—British Insulated & Helsby Cables, Ltd.
Copper wire.—Elliott's Metal Co., Ltd.
Enamelled and silk-covered copper wire.—London Electric Wire Co. and Smiths, Ltd.
Galvanised iron wire.—R. Johnson & Nephew, Ltd.

H.M. OFFICE OF WORKS.
Electric wiring, H.M. Fuel Research Station, East Greenwich.—Malcolm and Allan, Ltd.
Installation of goods' lift, G.E. Co.'s building, Kingsway.—Medway's Safety Lift Co.

INDIA OFFICE.
Cables.—W. T. Glover & Co.
Cells.—General Electric Co., Ltd.; Chloride Electrical Storage Co.
Copper tubing.—Yorkshire Copper Works Co.
Dynamos.—J. Stone & Co.
Phantophones.—Automatic Telephone Manufacturing Co., Ltd.
Telephone sets.—Peel-Conner Telephone Works.

Luton.—Electricity Committee. Recommended :—
One 300-KW. rotary converter, £1,831.—British Thomson-Houston Co., Ltd.

Switzerland.—Messrs. Piccard-Pictet & Co., of Geneva, have recently secured a contract for the supply of a Francis vertical-shaft turbine, of 10,000 H.P. capacity, for the hydro-electric station of the Société d'Electricité de Fribourg.

NOTES.

The Compliments of the Season.—The ELECTRICAL REVIEW wishes all of its readers and other friends a Prosperous New Year. We trust that the period of transition, with all its difficult problems, will be safely passed through, and that in the course of a few months all connected with the industry will have satisfactorily changed over to their former pursuits, and will have reason to feel, long before 1919 closes, that they are on the high road to a prolonged period of unprecedented success.

British Oil.—According to the daily Press, Lord Cowdray's drillers at Hardstoft, Derbyshire, have already sunk about 1,000 ft. of the first bore by which oil for the Navy is expected to be obtained. The drills are now working in the coal strata, and another 2,000 ft. will have to be bored before it will be definitely known whether oil exists there. The work goes on smoothly at 40 ft. to 70 ft. a day. Drilling at two other sites near Chesterfield will soon be in full swing.

"An English company is being formed, with £100,000 capital, to test low-temperature processes of obtaining oil from minerals," Dr. F. Mollwo Perkin is reported to have said, and "a great deal of experimental work is being carried out, and several large schemes are under consideration."

Insulated Wire and Cable Conservation.—In order to prevent the manufacture of many unnecessary types and grades of wire and cable in the United States, at a meeting of the rubber-insulated wire and cable industry, called by the War Service Committee of that industry, it was voted to submit to the War Industries Board the following programme for the conservation of rubber-covered wire and cables :—

I.—Manufacturers to carry in stock but one grade of any given type and size of wire.

II.—Stop the manufacture and sale of rubber-insulated national electrical code double-braided wire No. 8 B. & S. gauge and smaller, and national electrical code twin wire No. 8 and smaller. Substitute therefor single-conductor single-braid wire.

III.—Limit the number of colours to be used on outer braids of flexible cords, silk, cotton, or mercerised thread to four—namely, black, green, yellow, and red (white not counted as a colour).

IV.—No cartons to be used in packing flexible cords or other wires. However, present stock of cartons may be utilised.

V.—Reduce the number of standard types of national electrical code flexible cords and portables.

VI.—Conserve tin in stranded conductors of seven wires or more ; wires not coming in contact with the insulating compound (*i.e.*, wire strands) not to be tinned.

VII.—Eliminate wires of special diameter in manufacture of stranded conductors and conform to a table given.

Educational.—The Leeds Education Committee has decided to continue the wireless instruction department of the Technical School, which was established in September, 1917, on a fee-paying basis.

A Blackburn Dinner.—The closing of the Munitions Department at Blackburn Electricity Works was celebrated on December 18th, by a dinner attended by the whole staff. Mr. P. P. Wheelwright, electrical engineer, said that since the works were established three-and-a-half years ago, they had handled 350,000 shells, of which 95,000 were 6-in. shells. This was the third largest output of any factory in N.E. Lancs. Blackburn was one of the few electricity works in the country where munitions had been manufactured, and he was justified in saying it was the largest shell factory controlled by any corporation.

Tungsten Output.—In an interesting article on this metal in the current issue of *Salvage*, it is pointed out that out of a total of 19,000 metric tons of tungsten concentrates (60 per cent. WO_3) produced in 1913, England controlled and acquired 13,000 tons, or over two-thirds of the world's supply.

Appointments Vacant. — Power-house superintendent (£350) for the Stoke-on-Trent Corporation electricity works ; instructors in electrical engineering for the Leeds Education Committee Technical School ; charge engineers (57s. 6d. + 12 per cent.) for the R.E. Camps under the Ripon Command ; instructor in electrical work for the North Wales Joint (Disablement) Committee of the Ministry of Pensions, Bangor Centre. See our advertisement pages to-day.

The Channel Tunnel.—The *Railway Gazette* states that the Paris Municipal Council on November 22nd adopted a resolution in favour of the resumption of work on the construction of the Channel Tunnel, as sanctioned by the Law of August 2nd, 1875.

Rathenau on "Innocence and Justice."—In reproducing the following in parallel columns we do not think that any comment is necessary :—

London evening paper, December 20th, 1918.

MAGNATE'S WHINE.

CHIEF OF THE GREAT A.E.G. CRIES FOR MERCY.

The Dutch paper *Handelsblad* publishes a rhetorical appeal from Dr. Walter Rathenau, the head of the Allgemeine Elektricitäts-Gesellschaft, in which he declares that the German nation is innocent, and committed whatever wrong was done in innocence, and from a childish dependence on its masters.

"If the Entente Powers kill Germany in the name of justice," he says, "then justice will never again be what it now is.

"If a decision is now taken against us, we will bear our lot and perish upon the earth. You will hear no complaint, but our complaint will be heard where never yet has a complaint from human hearts arisen in vain.—*Reuter.*"

(*Extract from an article in the Berlin "Lokal Anzeiger," from the pen of Dr. Rathenau. See* ELEC. REV., *January 26th, 1917, p. 97, for fuller reference to this matter.*)

"We began the war a year too soon. When we have secured a German peace we must begin at once a reorganisation upon a broader and firmer basis than ever before. Establishments that produce raw materials essential to the Army must not only continue their work, but enter into it upon lines of increased energy, forming thus the kernel of economic Germany in preparing in the economic sense for the next war. We must carefully calculate in advance, in view of lessons learned in this war, what our country lacks in raw material, or essentials of raw material, and secure immense reserves to remain unused until a day in the future. We must organise as genuine an industrial mobilisation as we had a military mobilisation. Every technician, or semi-technician, enrolled or not in the list of mobilised, must be empowered through official credentials to take charge and direction of a given establishment upon the second day following a new declaration of war. Every establishment manufacturing for commercial purposes must be mobilised also, and understand officially that upon the third day after declaration of war its entire abilities are to be devoted to serving the Army upon demand.

"It must also be determined in advance just what quantities and sort of essentials such establishment can furnish the Army in a given time. Each establishment also should be required to furnish a detailed list of workmen who can be dispensed with, these alone to be mobilised in the military sense."

Institution and Lecture Notes.—Royal Society.—At the meeting of the Society held on the 5th inst., Mr. C. Chree, Sc.D., F.R.S., submitted a paper on "Electric Potential Gradient and Atmospheric Opacity," at Kew Observatory. The author states that it has been the practice for many years at Kew Observatory at the ordinary hours of meteorological observation to record the most distant of a selected series of objects which is visible at the time. Separate notes are also made of the presence of mist or fog. Thus a large amount of information has been accumulated as to the greater or less opacity of the atmosphere. The present paper utilises the data for a comparison of atmospheric opacity and the potential gradient of atmospheric electricity. It is found that even for the smallest amount of opacity which the observation scheme is able to disclose, the value of the potential gradient increases with the opacity. The effect of mist or fog on the potential gradients recorded in winter is large, and there being a large diurnal variation in the incidence of mist or fog, there is consequently a noteworthy influence on the character of the diurnal variation of potential gradient.

Institution of Electrical Engineers.—Mr. C. H. Wordingham, president of the Institution, addressing a meeting of the Scottish Centre at Glasgow, on December 16th, said it was proposed to apply for a charter for the Institution. As at present constituted, the Institution could not look after the interests of every branch of the industry. Separate Associations must be formed to deal with separate interests, and all these Associations should be linked together in one main body, so that when occasion arose there would be one organisation to act and speak for the industry.

Illuminating Engineering Society.—At the meeting on the 19th inst., papers were read and discussed on photometric tests of parachute lights and flares, self-luminous paints used for naval and military purposes, and on integrating photometers.

The president (Mr. A. P. Trotter), in opening the session, said that before it was brought to a close he hoped a Treaty of Peace would have been made. But it was difficult to treat with a people who had lost all sense of honour. German men of science had made, unasked, two deliberate pronouncements of hostility to scientific men of the Allied nations.

If among German and Austrian scientific men there had been one who was ashamed of the dishonourable and bestial conduct of their countrymen in the war, not one had had the courage to admit it. In these circumstances, what could they be but outcasts from

intercourse with nations like our own, in which the individuals would rather perish than prostitute their consciences as the Germans had done, to the lusts of a brutal and unscrupulous Government? While Labour, materials, and Capital were in a confusion undreamed of in the postulates of the academic economist, Science could detach herself and press steadily on.

Junior Institution of Engineers.—The new president, Colonel R. E. B. Crompton, C.B., delivered his inaugural address on "What the War has Done for Engineers, and the Part Engineers have to Play in Reconstruction," on Friday last. He said that ever since mankind divided itself into the two groups of those who *worked* and those who *talked*, the talkers had had the upper hand, and had always attempted to be the governing body. But the war changed all that. One year of war showed that nine-tenths of the work was essentially the work of the engineer, and in every department of Government, engineers found themselves forced to the top. The status of engineers in regard to the body politic had reached a point which it would have taken many years to reach if it had not been for the war.

With regard to the problems of reconstruction, he drew attention to various branches of engineering work which would demand their earnest consideration. Referring especially to road transport, he said that when road vehicles could be driven by power derived from a side wire by a trolley-pole, very great economy in tare weight of the propelling vehicles could be obtained, as the weight of the electric motor and its gearing was much less than that of the petrol motor or the steam unit. His most advanced idea was that it would be wise to develop the use of electrically-driven road trains, each train consisting of four three-axle vehicles; it would be possible to load each of these axles to eight tons, or a total moving weight of train close on 100 tons, without the road crust being stressed in excess of what was now the case when a motor-wagon, with back axles loaded to eight tons, passed over it at the same speed. He estimated the working cost of a train consisting of four such vehicles, carrying a maximum fuel load of 32 tons, and, therefore, probably weighing under 60 tons, at 1·51d. per net ton per mile, of which the wages charge was only ·22d. per ton mile. This subject of road trains, combined with electric driving, merited careful consideration. On the subject of railway reconstruction he dealt with the proposals of Gattie to establish clearing-houses at large railway centres, so as to reduce the number of goods wagons required for the transport of goods by loading their contents into containers. He agreed that if Gattie could only carry out a part of what he promised, he would have done well. Looking at it from the road user's point of view, he was not wholly satisfied that Gattie's large containers would greatly facilitate the distribution of goods, whenever these had to be carried partly by rail, partly by road.

Col. Crompton proposed to reduce the huge cost of the terminal transfers by his own transfer system; he gave the name of transfer to a motor-box or frame, of a size that could be placed transversely on railway wagons, could be pushed on to them from the side, and unloaded by being pushed sideways on to the road wagon. At suitable points on the main line which carried goods traffic, instead of the usual roadside station, with its sidings, goods sheds, and the like, it would only be necessary to provide platforms of a suitable height, by which the road wagon could approach the railway wagon sufficiently close to allow the loads to be moved from railway to road wagon, or *vice versâ*.

The transfers might either be the property of the railway company or of the road-carrying companies. The 3-ton motor-wagons which would be returned from France when the war was over would be, for a long time to come, largely used for road transport.

Touching the future of manufacturing by machinery in quantity, he said that in the past our inland and export demand had rarely allowed our manufacturers to put in orders in large numbers, exceeding one thousand, at a time. The bulk of the output from our engineering works, however, since it had been standardised, had been in orders up to many thousands at a time.

At this parting of the ways, it became of paramount importance to carry on the manufacture of goods on the same scale as we had carried out the manufacture of munitions during the war. The workers in America undoubtedly had been able to secure for themselves good wages, reasonable hours, and a degree of comfort, without the price of the article made by them being high; but the American workman had undoubtedly lost individuality and interest in his work. The question was whether the same high wages as had been earned in America on these automatic performances could be received here without such soul-destroying results.

Electrical Engineering in Italy.—Mr. E. Morelli recently discussed this question at length before the Italian Association of Electrical Engineers. According to *L'Elettrotechnica*, he mentioned the directions in which foreign competition had been most active, and advocated Government action to assist the development of native industry. It was expected that the development of water-power stations in Italy would proceed rapidly when the industry returned to normal conditions, and in this connection the manufacture of machinery and accessories on a large scale should proceed *pari passu*. As regarded the general measures for encouraging the electrical engineering industry in Italy, he recommended that increased attention should be given to the design of generators and motors and to improving the mechanical, magnetic, and electrical properties of materials of construction and methods of commutation and compensation, as well as cooling. Attention should also be paid to the special requirements of cotton-spinning mills, sawmills, paper mills, printing works, &c.; and the principle of separate motors for machines or groups of machines should be followed as far as possible, instead of having a main driving motor for the various workrooms.

The question of the best system to adopt for electric railways was considered at some length. Owing to the special conditions of working, single-phase current was not suitable, in spite of its advantages. Many engineers were inclined to favour the low-frequency three-phase system which had been successfully applied on some mountain railways. Some of the disadvantages of this system might be partly obviated by building experimental locomotives of the three-phase type with ordinary frequency and higher working voltage than was usual (as there were many systems of speed reduction applicable at the present time). If this were successful, one of the gravest objections to the present system in Italy would be removed—viz., the special frequency used (50/3 cycles per second).

As regarded the general question, standardisation should be the key-note of the future, and greater attention should be paid to specialisation of design and mass-production. As regarded some insulating materials and alloy sheets for dynamo stampings, much yet remained to be done in Italy to render her independent of foreign supplies, but the author believed that Italian metallurgists and insulating material manufacturers would be able to solve the problems set them.

The Romance of Electricity.—On Sunday evening, Dec. 8th, at Coventry, Mr. A. P. Young delivered an interesting lecture, entitled "The Romance of Electricity." The chair was occupied by Mr. H. J. White, and there was a record audience. With the aid of numerous slides, films, and experments, the lecturer traced the development of electricity and magnetism. The various purposes to which electricity had been applied were demonstrated, and at the conclusion, Mr. Young explained what was meant by the all-electrical scheme put forward by the Coal Conservation Committee some 12 months ago.

On December 16th, Mr. W. M. Selvey, of Sheffield, addressed the Bradford Engineering Society on the reports on Electric Power Supply.

Financial Facilities for Trade.—The Report of the Committee that sat to investigate this matter has just been issued. We hope to refer to it more fully later.

The Ford War Output.—Sir Percival Perry, chief director of the Ford Motor Works at Trafford Park, is reported to have stated to a meeting of employés last week that the war work of the company consisted of 38,296 cars, 6,366,000 explosive container tubes, 3,700 plough conversions, 3,928 master gauges and jigs, 48,341 car bodies, and 6,000 Fordson tractors. A 40-hour week will begin at the works with the New Year, as against the present 48. Wages are to be advanced from 1s. 3d., the present minimum, to 1s. 10d. per hour. Women are to participate in the profit-sharing scheme.

Volunteer Notes.—The Headquarters of the Royal Engineers' Volunteers, London Army Troops Companies, will be closed from December 30th to January 4th, and no parades will be held.

Football.—The second of the series of football matches between the Magnet F.C. and the remainder of the G.E.C. was played at Dulwich, on Saturday last. In the first match the "Old Crocks" were victorious, but this time the Juniors gained a creditable victory, scoring two goals to their opponents' one. Whitford scored for the G.E.C. after about a quarter of an hour's play, but although the Magnets did a lot of pressing, they could not score, owing to Maddams's fine display in goal. Soon after half-time, however, Joseph equalised, and a few minutes before time Brown scored the winning goal, amidst great applause. The feature of the afternoon was the play of Maddams in goal, but for whom many more goals would certainly have been scored against the G.E.C.

Inquiries.—Makers of the "Simplex-Coventry" lighting set are asked for.

Industrial Committees.—The activities of the Ministry of Reconstruction in the formation of Interim Industrial Reconstruction Committees—or temporary Whitley Councils, as they are sometimes called—will be resumed after the holiday period. Full Trade Conferences have been arranged for the tubes and paper-making industries. They will be held in January, under the presidency of Mr. E. J. P. Benn, Chief Trade Organisation Commissioner of the Minister of Reconstruction and Chairman of the Industrial Reconstruction Council.

German Protective Devices Against Surges.—German patent No. 291,498 of E. Nytborck describes a fuse, the operation of which depends on electrostatic attraction. A U-shaped filament is connected in the circuit and suspended in a tube containing oil. At the lower bend the filament lies between two plates, one earthed and the other connected to the line. If the line to be protected rises in voltage beyond a safe limit, the filament is attracted so as to touch the earthed plate, and fuses in consequence. The rupture takes place under the oil. Another patent, No. 288,373, of the Siemens-Schuckert works shows an ingenious construction of subdivided cables, so that they may afford an obstruction to incoming surges. The cores of the cables are crossed at certain points, so that outer strands proceed into the interior of the cable and *vice versâ*. Rapid oscillations tend to remain on the surface of the cable, and, when they reach the cross-over and are led into the centre, they have to find a path to the outer strands again. Only a part of the surge finds this passage, and the remainder is reflected back along the outer strand. The action is assisted by including choking coils at the points where the strands pass from the inside to the outside of the cable, or in the reverse direction, and also by providing resistance bridges from an outer to an inner conductor, where the interchanges of position take place.

Mr. Winston Churchill on the Change-Over.—On Saturday last Mr. Winston Churchill, Minister of Munitions, addressed a joint conference of employers and trade union representatives on the measures taken by his department to turn over to peace industry. The first task was the liquidation of contracts; the second was the rendering of assistance of various kinds to firms to turn over from war industry to peace industry; and the third was the disposal of stocks of materials, properties, and stores of all kinds, amounting to nearly 1,000 millions in value. They had to get the best prices for the Exchequer without discouraging and dislocating the normal industries of the country and delaying their revival through throwing great masses of new or part-worn surplus products upon the market. This seemed to him to be one of the most intricate business problems that had ever been set. He hoped that by the end of January the staff of his Department would have been reduced by at least 4,000 persons. The diminution of staffs would be followed by the disgorging of hotels. But during the greater part of 1919 the liquidation of contracts and the sale of stores, apart altogether from the normal business of the Ministry of National Supply, would require the maintenance of a very large staff at headquarters. The inspection staff of 70,000 persons had been effectively reduced during the past six weeks, and by the end of this week 20,000 to 25,000 would have been released. But the inspection staff had now to inspect and schedule the stocks of finished and unfinished munitions, so as to assist in the rapid settlement of accounts between contractors and the Ministry of Munitions. In the course of his reference to the output of shells, Mr. Churchill said that nearly 230,000 persons would have left munitions production by the end of this week. As far as the engineering shops were concerned, we were bound to have a period of dislocation extending over several months. Not only had new projects got to be undertaken, but the shops had to be cleared for new arrangement of machinery. It was inevitable that there should be a period of more or less severe dislocation throughout the great engineering trades by the transition from war to peace, but the difficulty would have been seriously aggravated if a similar disturbance and arrest of production had extended to the basic trade, the great steel trade, upon which, as a foundation, all our engineering activities stood. The arrangements which had been made to turn the steel trade on to peace production appeared to be working extremely well. Orders were being booked for export, and so far as home production was concerned the steel works were already fully occupied. That was a very satisfactory step on our anxious and lengthy journey from war to peace. After alluding to orders for the release of tools and metals, the speaker referred to the efforts of the Government in placing orders to develop alternative industrial productions as a stop-gap pending the transition. The superintending engineers of the Ministry of Munitions distributed all over the country were advising and assisting firms in their areas. The local boards of management were also co-operating in every way. They were making special efforts to obtain orders from Government Departments, from the Colonies, and the Dominions, and from public bodies, with a view to placing them to the greatest advantage. When necessary he was prepared, in connection with Government schemes, to place covering orders for commodities which would clearly be required in considerable quantities if private orders were not forthcoming. For instance, he had arranged with the Railway Executive Committee and with the Board of Trade to place orders, if necessary, for 1,000 locomotives and 30,000 or 40,000 wagons in the shops of the country.

Arrangements were being made with the Local Government Board for the Ministry to place large orders for articles required in connection with the Government's housing schemes; such articles as fittings for gas and electric cooking and lighting, &c. Contractors would be well advised to get into communication with the Ministry of Munitions showing their desire to obtain orders of this nature. It was idle to suppose that we could bridge the next three or four months without a certain degree of dislocation and of unemployment.

In looking forward to the future, Mr. Churchill desired to emphasise the real importance of everybody endeavouring to stimulate alternative peace productions and taking every step in reasonable relation to that. "Let every man endeavour to find his peace job, and let the country as a whole have courage and confidence in its immediate future. . . . There ought to be a period of great activity following this transitional period, and everyone should look forward to the future in the spirit of hope and of confidence, for by that process they will more or less stimulate the revival which they desire and which is so essential to our well-being."

The Westinghouse Manager and Engineering Output.—The *Manchester Daily Dispatch* on Saturday last published an interview with Mr. H. Mensforth, manager of the British Westinghouse Co., and the new president of the Manchester and District Engineering Trades Employers' Association. He said there were years of ample trade ahead, but to obtain it ca' canny methods would have to cease, and no restrictions must be put on the development of machinery to obtain the maximum output with the minimum of energy. Mr. Mensforth said that at present many customers would not place orders because of the impossibility of firms giving definite prices and times of delivery. As an instance of the loss of trade through the latter, he mentioned that the Westinghouse Co. had an order from Norway for a lot of switchgear, but through the Government not giving a promise as to priority until too late the firm was unable to guarantee deliveries as required, and the order had gone to the Siemens-Schuckert Co., in Berlin.

A great question now was whether the skilled men's unions were going to realise that maximum production was as much in their own interests as the employers'. "In other words, if employers were willing to put down modern machinery and use modern methods, are the unions prepared to allow the fullest output? If the answer is in the affirmative—and there will be the maximum production in America, and certainly in Germany also—then not only shall we absorb all the skilled labour available in the country, but all the semi-skilled as well, and also as many of the unskilled men now engaged in engineering works as are capable of being utilised." "If the skilled man will make it his interest so to develop machinery that we can get the maximum of output with the minimum of energy, the 47-hour week, too, will have the sympathy of any good employer. We need not have the slightest fear of the future," declared Mr. Mensforth.

Industrial Lighting.—A good overhead system of lighting is the modern standard for industrial establishments, and usually provides all the light that is required for the lighting of most interiors. Quite frequently, however, local lighting is employed in addition to the overhead lighting for certain machines or locations in the shop.

To assist local lighting it has been found that the use of white paint has proved very effective. In one case a large machine shop, containing massive vertical slotters, was lighted with an overhead system to an average intensity of about two foot-candles. The heavy machines were finished with very dark paint, so that the lighting of the tables in the region where the cutter operated was insufficient for setting the cutter accurately to the pencil markings on the rough castings ready to be machined. As a remedy a lamp on a drop cord was provided for each machine, and the surfaces of the machine which faced the table were painted

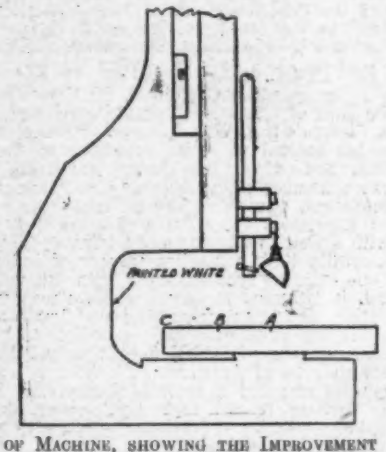


DIAGRAM OF MACHINE, SHOWING THE IMPROVEMENT IN LIGHTING OBTAINED BY PAINTING THE VERTICAL SURFACES OF THE MACHINE FACING TABLE.

white. This improvement avoids any shadows from the local lamp, as the reflection from the white painted surfaces softens the shadows very materially and increases the illumination on the table by about 75 per cent. Thus (see accompanying illustration) the foot-candle meter readings taken at the base-plate showed an improvement with the use of paint of 100 per cent. in the lighting at the points A and C, and over 50 per cent. at the point B.

Owing to the present necessity for strict economy by reason of the coal restrictions, the use of white paint would appear to be a most desirable practice for all machines and workshops.

National Control of Electricity in West Prussia.—Among the numerous treatises which have recently appeared concerning the management of the supply of electricity, one by Regierungsbaumeister a. D. Aschoff deserves special notice. The author assigns the duty of producing electricity to the State, and the distribution to the provincial associations, and supplies a number of interesting figures. He calculates the total energy requirements in Prussia at 17 milliard K.W.-hours, and the surplus profit for the State from the annual energy production at Mk. 25 millions, a sum which, in consequence of compensations paid to the compulsorily suspended existing power works, would be reduced by Mk. 38 millions, thus effecting a loss of Mk. 13 millions. From the distribution of the energy he estimates a profit of Mk. 177 millions, so that from the entire management of the electricity a net surplus would remain of Mk. 164 millions. The State will take 50 per cent. of this, viz., Mk. 82 millions, the other moiety will be assigned on an ingenious and equitable scale to the provinces, whose shares vary from Mk. 20 millions annually (Rhine Province) to Mk. 1½ million (West Prussia). —*Kommunale Praxis*, October 12th.

Industrial Fatigue.—A Reacarch Board has been appointed by the Department of Scientific and Industrial Research and the Medical Research Committee jointly to consider and investigate the relations of hours of labour and of other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers.

The *Times* states that the duty of the Board will be to initiate, organise, and promote by research, grants, or otherwise investigations in different industries with a view to finding the most favourable hours of labour, spells of work, rest pauses, and other conditions applicable to the various processes according to the nature of the work and its demands on the worker.

For these investigations the Board looks forward to receiving the help of employers and workmen in the industries which are studied, and in appropriate cases representatives of both will be invited to serve as temporary members of the Board. The Board has been constituted as follows:—

Prof. C. S. Sherrington, ScD., F.R.S. (Professor of Physiology, University of Oxford), chairman.

E. L. Collis, Esq., M.B. (Director of Welfare and Health, Ministry of Munitions).

Sir Walter Fletcher, K.B.E., M.D., F.R.S. (secretary, Medical Research Committee).

W. L. Hichens, Esq. (chairman of Messrs. Cammell, Laird and Co., Ltd.).

Edward Hopkinson, Esq., D.Sc. (director of Messrs. Mather and Platt, Manchester).

Kenneth Lee, Esq. (director of Messrs. Tootal, Broadhurst, Lee Co., Ltd.).

T. M. Legge, Esq., C.B.E., M.D. (H.M. Medical Inspector of Factories).

Colonel C. S. Myers, M.D., F.R.S. (director of the Psychological Laboratory, Cambridge).

R. R. Bannatyne, Esq. (assessor representing the Home Office).

D. R. Wilson, Esq. (H.M. Inspector of Factories), secretary.

The Board will be glad to receive suggestions as to any problems of the kind described. All communications should be addressed to the Secretary, Industrial Fatigue Research Board, 15, Great George Street, Westminster, S.W. 1.

Posts for Ex-Officers.—A letter to *The Times*, of December 10th, signed by Captain F. Le Neve Foster, secretary of the Inns of Court Regimental Association, 10, Stone Buildings, Lincoln's Inn, W.C. 2, draws attention to a scheme which he has started to assist ex-officers to find suitable employment, and which has shown good results. Under this scheme a number of gentlemen in positions of influence in the professions, commerce, and industry have volunteered a personal interest in the welfare of a selected number of officers, with a view to advising and finding suitable openings for them, within their respective spheres of influence. For instance, one eminent civil engineer, with interests at home and abroad, is fathering the cases of six officer members of the association who have engineering qualifications. Captain Foster invites any gentlemen who are willing to help in this way to communicate with him, indicating the directions in which they may be of assistance and the type of officer in whom they are prepared to interest themselves. He will be pleased to forward to any such gentlemen a short list of officers of the type and qualifications desired, with any further details that may be required.

Lead.—In their Lead Market Report, dated December 20th Messrs. Jas. Forster & Co. say:—"Although restrictions to dealing in lead have this week been withdrawn, there is in no sense as yet an open market. So long as the whole of the supplies are in the hands of the Government, and this we believe is the case not only with respect to stocks here but also with all lead afloat, there will be no open market. Lead can only be obtained at £40 per ton for some time to come. No doubt with greater shipping facilities the large quantity of lead lying in Australia will in time be available. Production has been greatly stimulated during the last four years, particularly in America, and we anticipate ample supplies as soon as normal conditions obtain. On the other hand, there will be a sustained and heavy consumption. There have been no transactions on the market, but consumers have bought pretty freely for January at £40."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station and Tramway Officials.—The Erith Urban District Council has advanced the salary of Mr. J. C. WILLIAMS, the electrical engineer and tramways manager, by £150 per annum. The circumstance that this advance was granted spontaneously by the Council, without any application from himself, must be gratifying to Mr. Williams, but it will probably cause other engineers, whose Councils have so far forgotten to be either just or generous, to wish that the tide of good fortune would flow in their direction.

Aylesbury U.D.C. has appointed Mr. M. MORTIMER station superintendent at the electricity works.

Mr. A. SLAVEN, who is leaving the employ of the Urban Electric Supply Co. after 15 years' service, has been presented by the staffs at Newton Abbot and Dartmouth with a gold watch.

Mr. A. H. GATES, chief technical assistant at Luton Corporation electricity works, has resigned, having received another appointment.

Mr. S. COHEN, A.M.I.E.E., who recently left the position of senior charge engineer with the South Lancashire Tramways Co., to take up an appointment in the electrical department of the Oldham Corporation, was on 18th inst. presented with a dining-room clock from the engineering staff of the company.

Mr. PILLING, tramways manager, of Accrington, recently a candidate for the position of tramways manager at Huddersfield at a commencing salary of £600, and who lost the situation by one vote, has had his salary increased from £400 to £500 by the Accrington Council.

General.—Mr. C. G. QUETTON, A.C.G.I., has joined the engineering and technical advertising staff of Messrs. Greenly's, Ltd. Mr. Quetton, who took his engineering degree at South Kensington, has spent six years in practical work in England and the U.S.A. After transferring his attentions in the States to the publicity side of engineering he returned to England, and in 1908 became publicity manager to the Sun Electrical Co., Ltd., and later was with the Union Electric Co. in a similar capacity. During the past three years he has been mainly in Russia organising publicity for a large combine of British firms and assisting Allied war propaganda, from which work he returned to a minor technical position at the Air Board.

Sir J. A. F. ASPINALL is retiring from the general managership of the Lancashire & Yorkshire Railway Co. at the end of the year, and is to take a seat on the board. Major ARTHUR WATSON, C.B.E., M.Inst.C.E., superintendent of the line and assistant general manager, has been appointed general manager to succeed Sir John. He is 45 years of age. He was articled to the chief engineer of the railway in 1890.

Sir GUY GRANET will retire from the end of this year from the general managership of the Midland Railway Co., and will take a seat on the board. Mr. F. Tatlow, the deputy-general manager, becomes general manager.

Sergeant J. CONWAY PRICE, who recently had a severe attack of influenza, has been invalided Home, and is now in England, never more to return "over there."

The Victory number of the *Court Journal* contains an article on the "War Romance" of the firm of C. A. Vandervell & Co., Ltd., with a photograph of Mr. C. A. Vandervell.

Roll of Honour.—Lieutenant G. T. LYALL, of the Ontario Regiment, a Darwen (Lancashire) officer, awarded the V.C. for courageous conduct in the field, was an electrical engineer in Canada. He rushed a strong enemy point at Cambrai, and, single-handed, killed the officer in charge, subsequently capturing 45 prisoners and five machine-guns. During two days' operations he captured three officers, 182 other ranks 26 machine-guns and one field gun, exclusive of heavy casualties inflicted.

Private S. A. PLANT, Essex Regiment, who has been killed in action, was employed at the works of Messrs. Siemens, Stafford.

Alderman KNOWLES EDGE, Deputy Mayor of Bolton, last week presented the D.C.M., which was awarded at Gallipoli in January, 1916, to Sergeant J. G. JONES, R.F.A., who was employed as an electrician in Bolton.

Obituary.—MR. J. R. BERRY.—Amongst the many victims of the recent influenza epidemic (estimated to number about eight thousand in Cape Town and suburbs) is Mr. James R. Berry, the local manager of the Telegraph Manufacturing Co. Mr. Berry was a native of Bury, Lancashire, but had occupied his position in Cape Town for about eight years. Our Cape Town correspondent says that his wide knowledge and experience of electrical matters was always at the disposal of electrical engineers, and his genial disposition caused him to be endeared to a large circle of acquaintances, many of whom showed their appreciation by paying him the last mark of respect at his funeral. Three other victims were Messrs. JAMES MCCONVILLE and WILLIAM HOPE, foremen in the cable department of the Cape Town Corporation, and Mr. T. M. MASKEW, correspondence clerk in the electrical department. As about 75 per cent. of the staff of the electrical department were affected at one time, it can readily be understood that the supply was kept going under exceptional difficulties.

MR. W. MCCANNAM.—The death has taken place from influenza of Mr. W. McCannam, a member of the staff of the electric light works at Neston (Cheshire).

MR. W. YARDLEY.—The death occurred recently of Mr. W. Yardley, electrical engineer, of Leatherhead, aged 54 years.

MR. J. A. BAKER.—The death is announced of Mr. J. A. Baker, who was in business as an electrical engineer and contractor at Northampton.

MR. HARVEY DU CROS.—Mr. Harvey du Cros passed away suddenly on Saturday last at Dalkey, Co. Dublin, aged 72 years.

Wills.—The late Mr. JAMES O. CALLENDER left £17,320.

The late Colonel BERTRAM HOPKINSON, who was killed in a flying accident, left £16,457.

NEW COMPANIES REGISTERED.

English Electric Co., Ltd. (152,250).—Private company. Registered December 14th. Capital, £5,000,000 in £1 shares (1,500,000 pref. and 3,500,000 ord.). The pref. shares are entitled to a fixed cumulative preferential dividend at 6 per cent., and in a winding up they take priority as regards return of capital and arrears of dividend, but they carry no right to further participation in profits or assets. Each share confers one vote. The objects are: To carry on the business of electrical, mechanical, hydraulic, and general engineers and contractors, manufacturers of, and dealers in, vehicles, galvanic, and magnetic apparatus and appliances, suppliers of light, heat, sound, and power, manufacturers and repairers of, and dealers in, vehicles, cycles, engines, chassis, bodies, airships, aeroplanes, armour plates, gun mountings, missiles and explosives, dealers in petrol and other volatile oils and spirits, lubricants, metallic compounds and chemicals, &c. The first directors are:—C. T. Cayley, 5, Portland Place, W. (chairman of Dick, Kerr & Co., Ltd.); B. A. Firth, Norfolk Works, Sheffield (chairman of Thos. Firth & Sons, Ltd.); W. Rutherford, 3, Abchurch Yard, E.C. (managing director of Dick, Kerr & Co., Ltd.); J. Sampson, 8, The Sanctuary, Westminster, S.W. (director of John Brown & Co., Ltd.); P. J. Pybus, Thornbury, Bradford (managing director of Phœnix Dynamo Co., Ltd.); Col. J. H. Mansell, The Chase, near Coventry (managing director of Coventry Ordnance Works, Ltd.); A. Gracie, Fairfield Works, Glasgow, engineer; W. L. Hichens, 3, Central Buildings, Westminster, S.W. (chairman of Cammell, Laird & Co., Ltd.); C. E. Ellis, Rampton Manor, Notts., manufacturer. Minimum cash subscription, seven shares. Directors' qualification, £1,000. Remuneration, £250 each per annum, with £100 extra for the chairman, and, if the directors so determine, for the deputy-chairman. The directors may borrow on security up to the nominal amount of the share capital without the consent of a general meeting. Registered office: 3, Abchurch Yard, E.C.

CITY NOTES.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

The annual meeting was held on Thursday, December 19th, at the offices, 106, Cannon Street, E.C. Major LEONARD DARWIN, who presided, said that early in the year the death occurred of Mr. G. W. Smith, extraordinary director, who for 50 years had faithfully served the company in France. He was appointed manager in 1870, during the time when their factory at Persan was occupied by the Germans, and he had only relinquished his charge at the beginning of the present war, when Persan was again threatened by a second occupation. In addition, they had also to note with regret other losses in the English staff. Mr. Geale, the accountant, who had been with them 35 years, Mr. Williams, the controller of agencies, with a record of 43 years, and Mr. Stables, for many years manager of the india-rubber department at Silvertown, had all passed away. Capt. Nigel Hanbury, a director, who had been with the Colours since October, 1916, was still away on the Continent. Col. Jarvis, who had served since the commencement of the war, and went through the trying experiences of Gallipoli, was happily with them that day, on leave. Having referred to the appointment of Mr. Russell, the manager at Silvertown, as an extraordinary director, the chairman said that the net profit, after making provision for doubtful debts and excess profits duty, was £143,589. That had allowed the directors to put £50,000 to the reserve fund, and to carry forward the substantial sum of £90,955. He thought they would agree that it was very satisfactory to have a reserve fund (£500,000) which was equal to the whole issue of their ordinary shares. For many years it had been the ambition of those who had the interests of the company at heart to be able to reach that figure. As to the future, they had now to study and carry out the necessary changes which would help them to bridge over the transition period between war and peace conditions. That was a very serious problem, and it was made the more so by the fact that the Government had not yet been able to give the country any information of a definite nature as to their future fiscal policy in connection with our Colonies and foreign countries. During the war their turnover had greatly increased, both in volume and in value. They had had, it was true, to sacrifice their pre-war business, and use their plant for the production of great quantities of Government requirements, manufactured from materials at artificially inflated prices, and with increased labour costs. It was an easy operation to lose one's business, but, as they could all imagine, it was one of very great difficulty to regain lost trade. Home competitors, who had done less war work than they themselves had, had been able to invade their home markets, whilst the advantages reaped by neutral countries by invading their foreign markets would not cease to be felt with the advent of peace. They hoped, however, to regain those markets as soon as they could put themselves in a position to produce their manufactured articles in the necessary quantity and quality, and at competitive prices; and, in addition, they thought that some of the information obtained and lessons learned during the war period might be of considerable assistance to them in reaching that goal. During the period of reconstruction, it was obvious that their aim should be to so adjust their operations that as much as possible of the labour at present employed should be smoothly transferred from war work to more peaceful occupations, but in those operations they must not forget what they owed to those members of the staff who had been fighting their country's battles at the Front, and whose claim to employment stood first. All those questions of material, labour, and markets presented great difficulties, but with a knowledge of the business, and given the necessary support from the Government whilst their control continued, they hoped, and thought that they would be able to steer the company's barque through the troubled waters of reconstruction on a comparatively even keel. Their factory at Persan had done very well during the year under review. At the height of the German offensive last spring the position there again became critical, and the French Government intimated that, in distributing their orders, preference would be given to firms at some distance from the Front, where there was less chance of the work being interrupted by the enemy. In order to comply with their views, they took over a small factory in the South of France, to which they could transfer the most important plant in case the advance seriously threatened Persan. Luckily, they were not driven to that expedient, and now they could either dispose of the property on satisfactory terms, or retain it as a second string to their bow in France, whichever proved advisable. He was glad to be able to state that they had started work in their new factory at Burton. The Government had assisted them by allowing a considerable depreciation to be written off the buildings and machinery before arriving at the sum liable to excess profits duty, and the position of the factory, from the point of view of coal, labour, and transport facilities, was such that they had every reason to hope it would prove a valuable addition to the productive capacity of their firm. The period of reconstruction which lay before them gave rise to no little anxiety, and the results of the current year might well prove disappointing. However, they could only deal with the various problems as they arose, to the best of their ability, which, he thought, must be the attitude and methods adopted by all the industries of the country. Having paid a tribute to the excellent way in which the staff of the company had worked throughout the period of the war, he said that the critical times were not yet over. He thought they might look forward to what was coming this year with confidence. The critical times would really begin next October, but, although they would be critical, he did not think they need have any fear.

Mr. C. H. GRAY seconded the motion, and the report was adopted without discussion.

Edison Swan Electric Co., Ltd.

For the year ended June, 1918, the balance to credit of profit and loss account is £129,210, plus £13,267 brought forward. Interest on both classes of debenture stock has absorbed £19,119; interim dividend on the first pref. dividend to January, 1918, £3,793; munitions levy balance £587; expenditure on bomb-proof shelters £1,403; special munitions plant, &c., depreciation £11,739; written off expenses of preference share issue £4,222; cost of debenture stock purchased for sinking fund £975; further provision for debenture sinking fund £8,612; 3 per cent. dividend on first participating preference shares £3,000; transferred to reserve £10,000; 7½ per cent. dividend on the "A" shares £28,761; leaving to carry forward, subject to excess profits duty, £50,265. The capital expenditure during the year, before providing for depreciation, amounted to £17,907 (buildings £2,731, plant and machinery £15,176). The plant extensions have been mainly in respect of special plant erected for carrying out Government contracts, and under arrangement with the Ministry of Munitions £11,739 has been written off as shown above. The new capital provided by the issue of preference shares and the improved organisation have had a very distinct bearing upon the increased profits shown. How far the reconstruction and reorganisation of the industrial undertakings of the country will affect the earning capacity of this company in the immediate future it is at present impossible to foresee. The directors hope that, given an adequate supply of raw materials and an equitable solution of the labour problem, satisfactory profits will be earned. The question of tariffs, however, is a highly important one for all electrical undertakings, and must not be lost sight of. As soon as more normal conditions with regard to the shipment of goods abroad are established it is hoped that the company's export business will become a valuable source of revenue. In order to carry into effect the general policy of expansion which the directors have in view it is proposed to take steps to make a further issue of ordinary shares, which in due course will be offered to the existing shareholders for subscription. The balance-sheet does not disclose the fact that the liability of £2 per shares has now been removed from the partly-paid £5 ordinary shares, or that these shares have now been split into the denomination of £1 each, as the order of the Court cancelling the liability was not made until after the date covered by the balance-sheet. A freehold property in the north of London has been purchased since the date of the balance-sheet for the purpose of manufacturing dry cells and batteries, the capacity of the existing shops at Ponders End not being sufficient to cope with the orders received, and, in addition, 10 acres of freehold land adjoining the Ponders End works have been purchased.

Annual meeting: December 30th.

Barcelona Traction, Light & Power Co., Ltd.—The financial Press states that at an adjourned meeting of the holders of the 5 per cent. first mortgage 50-year bonds, last week, resolutions were unanimously passed sanctioning the scheme of reorganisation.

Fullers' Carbon & Electrical Co., Ltd.—At the second annual general meeting held last week, Mr. George Fuller, M.I.E.E., the chairman, congratulated the shareholders upon their dividend of 10 per cent. on both classes of shares, as against 8 per cent. last year. The turnover had been increased threefold during the period. The company's products had largely superseded the foreign product, and they already had orders on the books equal to last year's entire sales. This had necessitated the erection of another large building, with a fully-equipped plant, which had materially increased the output.

British Coalite Co., Ltd.—Mr. W. J. Fisher, in the course of his speech to shareholders on December 18th, said that it had been suggested that greater economy and greater strength and efficiency would result from the amalgamation of four companies all tending to the same end:—the Barnsley Smokeless Fuel Co., Low Temperature Carbonisation, Ltd., Coalite, Ltd., and their own concern. If on closer examination the scheme proved feasible the shareholders of all the companies would be made acquainted with the details and called together.

Mirrlees, Bickerton & Day, Ltd.—The "Financial Times" says that the capital of this company is to be increased to £350,000 by the creation of 140,000 ordinary shares of £1 each. 55,000 of the new shares will be offered to ordinary shareholders at par, and 30,000 shares may be issued to members of the staff, employés, and agents of the company.

Callender's Share & Investment Trust, Ltd.—Dividend 3¼ per cent., less tax, for half-year, making 6 per cent. for year. £500 has been put to reserve, £741 written off preliminary expenses, and £5,305 is to be carried forward.

Victoria Falls & Transvaal Power Co.—According to the financial Press the net earnings, including those of the Rand Mines Power Supply Co., for the quarter ended September 30th amounted to £225,990, before providing for taxation in South Africa and the United Kingdom.

British Uralite (1908), Ltd.—Profit for the year ended June, £6,162. Dividend 5 per cent. to be distributed as soon as the liquid cash is available. The plant has been improved, increasing production and reducing cost.

Eastern Telegraph Co., Ltd.—Dividend at the rate of 3½ per cent. per annum, less income-tax, on pref. shares for quarter ended December; third quarterly interim dividend of 1¼ per cent. on the ordinary stock, free of income-tax.

Eastern Extension, Australasia & China Telegraph Co., Ltd.—Third quarterly interim dividend of 3s. per share, free of tax.

Marconi's Wireless Telegraph Co., Ltd.—Dividend of 7 per cent., less tax, upon the cum. participating preference shares, and an interim dividend of 5 per cent., less tax, on the ordinary shares.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in:—

Siemens Bros. & Co., Ltd.—120,000 shares of £5 each, fully-paid, No. 1 to 120,000.

Crompton & Co., Ltd.—Interim dividend at the rate of 7 per cent. per annum for the half-year, on the preference shares.

STOCKS AND SHARES.

SATURDAY MORNING.

THERE is not very much to tell about Stock Exchange markets, where business has come to nearly a full-stop on the eve of the extended holiday. The House has even recovered part of its old-time hilarity, and a good deal of quiet merriment is noticeable. At the same time, there is not a member in the House but has a personal loss to mourn, and this consideration forbids any such boisterous gaiety as used to distinguish the Stock Exchange in Christmas weeks before the war.

The Home Railway position continues to absorb mild interest, and, although prices gave way after their first improvement on nationalisation expectations, this decline has been followed by a small upward reaction, which has lifted prices a quarter to a half above their previous levels. Undergrounds are not greatly affected so far, but Metropolitans are firmer.

The question is being debated as to what is the status of a debenture stock, inasmuch as the answer to the problem may have a distinct bearing upon the price which is likely to be offered by the Government in taking over the securities. The best authorities declare that, in the case of a home railway company, the rights of debenture holders are limited to the appointment of a receiver, who has the power to operate the property for the benefit of the stockholders, but who cannot sell any part of it in order to repay debenture-holders' debt which the company owes them. In other words, it is held that a debenture in a British railway company is in no sense a mortgage, and therefore carries no such rights as falling to a mortgage debenture stock. The point is interesting, as already indicated, on account of the difference it may make to the price received by debenture stockholders if, and when, their security is taken over by the Government.

The Eastern Telegraph Co. has declared its usual quarterly dividend of 1¼ per cent., and the Eastern Extension Co. of 3s. per share, both of these being paid free of tax. The market in cable shares is a little dull for choice, though amongst manufacturing issues there is a decidedly good tone, and Callenders have risen to 10½ on top of their big rise of a few days ago. The Marconi group is also better, not so much in price as in sentiment. Business is quiet in the shares, and Americans at one time gave way to 29s. 9d. Then they rallied to 30s. 3d. Marconi Marines at 3¼ are 1/16 better on the declaration of an interim dividend of 1s. per share, less income-tax, on account of the current year. United River Plates are 1/16 up. In other telegraph and telephone issues there is little going on, and no change in prices.

Edison-Swan shares rose to 19s. 9d. on the declaration of a dividend of 7½ per cent., which is better than many had expected. The news was not generally known this (Friday) afternoon, and it may be that prices will improve unless there happens to be profit-taking to follow the announcement. The rest of the electrical manufacturing shares were very steady, prices, however, calling for no particular comment.

Amongst the foreign groups, although Mexican utility bonds are unchanged, the tendency is still depressed, and it is by no means easy to sell stock at the moment. The Argentine Tramway issues are also heavy, the first preference declining to 4 1/16 and the second preference giving way to 3¼. Canadians are rather better, and the 5 per cent. bonds of the Electrical Development of Ontario went up 2 to 88. No alterations have occurred in Brazilians. The rubber market is hard, and amongst base-metal shares, the removal of Government control from some of the principal metals has had no untoward effect upon prices of shares.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1916.	Dividend 1917.	Price Dec. 20, 1918.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	9	10	7½	—	£6 18 0
Charing Cross Ordinary	5	4	3½	—	5 14 0
do. do. do. 4½ Pref.	4½	4½	8½	—	6 13 4
Chelsea	3	5	4	—	6 5 4
City of London	8	8	13	—	6 3 1
do. do. 6 per cent. Pref.	6	6	10½	—	5 18 5
County of London	7	7	11½	—	6 5 7
do. do. 6 per cent. Pref.	6	6	10½	—	5 18 5
Kensington Ordinary	6	7	8½	—	5 19 3
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	4	5	4	—	6 5 0
Metropolitan	3	4	3	— ¼	6 13 4
do. 4½ per cent. Pref.	4½	4½	8½	—	6 18 6
St. James' and Pall Mall	8	9	7½	—	6 6 4
South London	5	5	8	—	6 13 4
South Metropolitan Pref.	7	7	20/6	—	6 16 7
Westminster Ordinary	7	9	7½	—	6 6 4
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	99	—	6 1 0
do. Def.	1½	1½	23½	—	6 9 6
Chile Telephone	8	8	7½	—	5 6 8
Cuba Sub. Ord.	7	7	10½	—	*6 18 4
Eastern Extension	8	8	15½	—	*5 3 3
Eastern Tel. Ord.	8	8	157½	—	*5 1 7
Globe Tel. and T. Ord.	7	7	14½	—	*4 16 5
do. do. Pref.	6	6	10½	—	5 14 3
Great Northern Tel.	24	22	83½	—	6 11 5
Indo-European	13	13	58½	—	5 11 0
Marconi	15	20	4½	—	4 6 7
Oriental Telephone Ord.	10	10	3½	—	2 17 2
United R. Plate Tel.	8	8	7 7/16	+ 1/16	*5 2 3
West India and Panama	6d.	1/3	1½	—	*3 12 6
Western Telegraph	8	8	10½	—	*4 18 7
HOME RAILS.					
Central London Ord. Assented	4	4	65½	—	6 2 2
Metropolitan		1	30½	—	3 5 6
do. District	Nil	Nil	26	—	Nil
Underground Electric Ordinary	Nil	Nil	8½	—	Nil
do. do. "A"	Nil	Nil	9/-	—	Nil
do. do. Income	6	4	9½	—	*4 8 0
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	42	—	6 6 4
Anglo-Arg. Trams. First Pref.	5½	5½	4	— ¼	—
do. do. 2nd Pref.	5½	—	3½	— 1/16	—
do. do. 5 Deb.	5	5	75½	—	6 13 3
Brazil Tractions	—	—	56	—	—
Bombay Electric Pref.	6	6	102	—	5 11 7
British Columbia Elec. Rly. Pfce.	5	5	67½	—	7 11 5
do. do. Preferred	Nil	Nil	53½	—	Nil
do. do. Deferred	Nil	Nil	46½	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	67	—	Nil
do. 6 per cent. Bonds	Nil	Nil	56	—	Nil
Mexican Light Common	Nil	Nil	38	—	Nil
do. Pref.	Nil	Nil	49	—	Nil
do. 1st Bonds	Nil	Nil	71	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	39	—	4 0 0
British Aluminium Ord.	10	10	31½	—	5 3 1
British Insulated Ord.	20	20	24	—	4 9 0
British Westinghouse Pref.	7½	7½	28	—	5 14 1
Callenders	20	25	10½	+ ½	5 19 1
do. 5 Pref.	5	5	5½	—	5 0 0
Castner-Kellner	22	20	3	—	5 19 4
Edison-Swan, "A"	—	—	—	—	Nil
do. do. 4 per cent. Deb.	4	4	75½	—	5 6 0
Electric Construction	7½	10	1½	—	8 0 0
Gen. Elec. Pref.	6	6	10½	—	6 2 4
do. Ord.	10	10	17½	—	*5 13 5
Henley	25	25	2½	—	5 11 5
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	17½	—	*5 12 5
Telegraph Con.	20	20	48	—	*5 0 0

*Dividends paid free of Income Tax.

CARBON BRUSHES: CONSIDERED IN RELATION TO THE DESIGN AND OPERATION OF ELECTRICAL MACHINERY.

BY P. HUNTER-BROWN, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE expression "carbon brush" is here used in a generic sense, and is intended to include brushes made of carbon and/or graphite, with or without the addition of various metals.

A demand is not infrequently made for a universal brush, or at most two qualities which will meet every case of commutating work, with a third quality for slip-rings. The requirements of modern machines, however, are too diverse and too exacting for such a thing to be practicable.

The wide adoption of commutating poles has reduced the duties devolving upon the brushes from the commutating point of view, but it has by no means eliminated them. The wide adoption of 50- and 60-period rotary converters produces difficulties inherently connected with the high frequency.

Special machines such as low-voltage aero dynamos and magnetos have brought in their train their own particular brush problems, demanding the development of special grades to meet the case in question.

To secure satisfactory operation, then, the problem may be stated thus:—

(*a*) In the case of slip-rings the brushes must maintain uninterrupted contact with the rings and carry the current with minimum frictional and electrical losses. Distribution of current between the various brushes must be sufficiently uniform to prevent local heating, and the rate of wear of both rings and brushes must be kept within reasonable limits.

(*b*) In the case of commutating machines the brush must run satisfactorily on a composite surface, and must possess the commutating characteristics necessary to give the required assistance in this direction, and must be capable of withstanding the unequal distribution of current which inevitably occurs in each individual brush.

Properties of Carbon Brushes.—In the manufacture of carbon brushes a well-equipped laboratory is an absolute essential if consistent results and uniformity of product are to be maintained. The properties must be studied individually and then collectively by running the brushes under actual operating conditions.

In this paper the word "collector" is used as a common term to denote either commutator or slip-ring.

The terms "positive" and "negative" are used in a motor sense; that is to say, by "positive brush" is meant the one by which the current passes to the collector, and by "positive ring" is meant the ring under the positive brush.

The resistance of graphite and carbon grades varies from a minimum of about 0.0003 ohm per inch cube to a maximum of about 0.0030 ohm per inch cube according to the proportion of graphite and other materials. Even taking the highest of these figures, the actual loss due to the resistance of the brush is only about 10 to 15 per cent. of the loss caused by friction and contact resistance.

The specific resistance has a much smaller influence in determining the carrying capacity of a brush than the contact drop, coefficient of friction, and thermal conductivity of the material.

If a small proportion of copper is added, the effect is actually to increase the resistance, though the alteration in the nature of the contact surface thereby produced may nevertheless prove very beneficial. By increasing the copper content the specific resistance may be reduced to about 0.000005 ohm per inch cube, there being still sufficient graphite in the brush to have a marked lubricating effect.

A low coefficient of friction is of vital importance with the high peripheral speeds of modern machines. Apart from the actual loss incurred, if the friction is high it may (though not invariably) lead to chattering of the brush. An imperfect contact between brush and collector, even if it does not produce destructive sparking, will at least increase the contact drop, so that the high friction increases the commutator loss directly, and also indirectly, by increasing the I^2R loss. Chipping and breaking at the contact surface are not by any means always attributable to high friction.

The coefficient of friction (μ) is influenced by the brush material, the composition of the collector, the condition of the surface of the latter, the pressure on the brush, the peripheral speed, and the condition of the atmosphere. The author has read a statement that μ may easily be increased 25 per cent. by heating, and again elsewhere that it decreases with an increase of temperature. He is of the opinion that no temperature variations likely to occur in practice affect the coefficient of friction.

The passage of current through a brush alters the nature of its contact surface and in this respect affects the friction. Samples for test should therefore be bedded with current flowing. After the surface appears to have been completely formed the first readings may be taken, but the test proper should continue for not less than three days with the machine running night and day.

The effect of a variation in the pressure applied to the brush is very marked. If the pressure is increased from, say, 2 to 4 lb. per sq. in. the friction loss is very much more than doubled. The explanation of this apparent increase in the coefficient of friction (which may be anything from 10 to 100 per cent.) is not obvious, but may be due perhaps to some kind of suction effect. That a partial vacuum is sometimes produced under a brush there seems little doubt. The phenomenon is probably confined more or less to the laboratory where the friction machines are maintained in specially good condition, and no doubt under normal working conditions there is sufficient vibration to prevent its occurrence.

The peripheral speed has a pronounced influence upon the coefficient of friction, the latter falling with an increase of speed, though not always to the same extent. Fig. 1 shows an instance in which the effect of speed variation upon the coefficient of friction is very great. An inspection of the curve reveals that the total friction loss was actually greater at the lowest speed than at the highest. It seems probable that this decrease of μ with increasing speeds is due to a film of air between the brush and the collector.

The contact drop of a copper gauze brush is of the order of 0.2 volt. With a carbon brush this is increased some 4 or 5 times. This contact drop is the most valuable property a carbon brush possesses. To quote the late Professor S. P. Thompson, "its presence is the whole secret of success in natural commutation. The price paid for the sparkless working of the machine is the voltage drop of 1.6 to 2 volts."

The voltage drop at the contact does not vary proportionally with the current, but remains remarkably constant over a wide range, and there is for each quality of brush a critical value below which no current at all will flow. In this respect the behaviour somewhat resembles that of an electric arc.

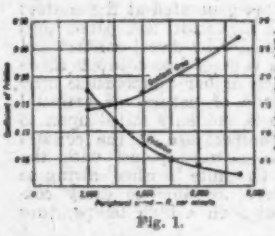


Fig. 1.

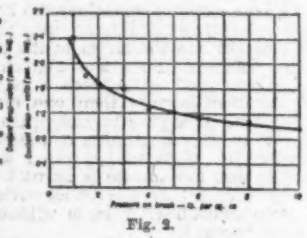


Fig. 2.

FIG. 1.—COEFFICIENT OF FRICTION AND CONTACT DROP AT 40 AMPS. PER SQ. IN. OF A PURE GRAPHITE BRUSH. PRESSURE 2 LB. PER SQ. IN.

FIG. 2.—CONTACT DROP OF CARBON BRUSH CONTAINING NO GRAPHITE. CURRENT DENSITY 40 AMPS. PER SQ. IN. SPEED 3,500 FT. PER MIN.

An exceptional case is depicted in fig. 1. This shows the coefficient of friction of a pure graphite brush at various speeds. The curve is so steep and the value of μ so low at the highest speeds as to suggest the air-film explanation mentioned above. Contact-drop readings were taken at the same time as the friction readings, and these also are plotted.

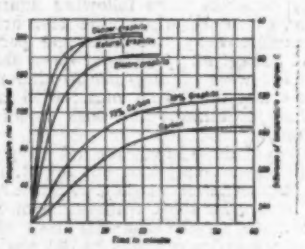


FIG. 3.

A large increase occurs in the contact drop as the speed approaches the maximum, again suggesting the presence of an air-film.

The immediate effect of an increase in temperature is usually a reduction in contact drop, but the extent is difficult to determine because the increase in temperature accelerates oxidation of the collector and this increases the contact drop. Many tests have been made, but it is not easy to obtain consistent results. Some tests have been made with the rings running at 3,500 ft. per minute, and with a view to eliminating some of the variables others have been made with the rings at rest. Starting with perfectly clean rings, generally speaking a drop of about 20 per cent. occurs very shortly after switching on. The contact drop then rises much above the original value. On cooling again, the behaviour is uncertain, but the contact drop does not return to anything approaching the original value. After cleaning the rings with fine glass paper without disturbing the contact surface of the brushes, a further test reveals a large reduction of contact drop.

The behaviour of graphite brushes appears to be more consistent than that of carbon.

In actual practice considering the combined effects of an increase of temperature per sec. and the resulting oxidation, it seems highly improbable that any large reduction in contact drop occurs, otherwise we should have an unstable condition of things, since the contact resistance forms such a large proportion of the entire brush resistance. If an increase of temperature produced a decrease in the total brush resistance, to attempt to run brushes in parallel would be similar to attempting to run compound dynamos in parallel without equalisers.

The contact drop is very definitely affected by the amount of pressure applied to the brush. A typical curve is shown in fig. 2, which refers to a carbon brush. The test was made at 40 amps. per sq. in., the speed being 3,500 ft. per min.

The thermal conductivity has a very definite bearing upon the performance of carbon brushes, as relatively very large amounts of heat are generated in very small volumes of material, and unless the heat escapes rapidly a destructive temperature rise is the result.

Over 90 per cent. of the loss occurs at the contact. Unequal distribution of the current, overloads, and circulating currents, all tend to increase and localise the heat still more.

The thermal conductivity of the various classes of brushes varies very largely It is greatest in the pure graphite and highly metallic copper-graphite brushes, and least in the carbons. In fig. 3 are shown the results obtained by heating blocks of various materials at one end and measuring the temperature rise at the opposite end.

Under working conditions the heat generated at the contact surface is dissipated partly into the collector, and partly into the brush, and therefrom to the holder by direct contact and also via the flexible. For a given contact loss a brush made of carbon is likely to reach a much higher temperature near the contact surface than one made of natural or artificial graphite. If a pure carbon brush is suddenly called upon to carry an excessive current the temperature at the contact surface is liable to be raised to glowing point, with the result that the surface is burnt. Graphite brushes, owing to their greater thermal conductivity, are able to carry correspondingly heavier loads without such a high temperature being reached.

Incidentally this great difference in thermal conductivity explains the observed fact that flexible conductors in graphite brushes are more liable to burn out than the flexibles in carbon brushes.

The terms hardness and abrasiveness are frequently confused, whereas in reality there is a very definite distinction between them. By the former is meant the degree to which the material resists permanent deformation, and it may be measured conveniently by means of a Shore scleroscope, or rough comparisons may be made by scratching tests. A brush may be very hard and yet only very slightly abrasive. Frequently a harder brush is asked for, when what is required is either a more refractory brush or a more abrasive one.

The purely mechanical abrasive action of the majority of brushes is very slight indeed, and in some instances it may be necessary in the course of manufacture to incorporate a small quantity of abrasive material to prevent a brush from smearing the collector.

Tests made with no current flowing, however, reveal that even the last-mentioned brushes do not produce very rapid collector wear by abrasion. The following figures relate to tests made upon bronze slip-rings, the test brushes being 1 in. thick circumferentially, mounted one per ring. The pressure was 4 lb. per sq. in.; peripheral speed about 4,000 ft. per min. The radial wear of rings per 20 million revs. with pure graphite was less than 0.001 mm.; with carbon (non-abrasive), less than 0.001 mm.; and with carbon (abrasive), less than 0.070 mm.

The most abrasive of these brushes is not a type that would be fitted upon high-speed machines, but might, for instance, be fitted upon a 4-pole motor running at 800 R.P.M. Assuming the brushes were ¼ in. thick with four mounted on each track of the commutator, then on the basis of the above figure to produce a radial wear of 1 in. on the commutator the machine would have to run 10 hours a day for 21 years, and this with a pressure double that to be expected in practice.

Design of Brush.—The use of large brushes effects economy in holders, but a moderately small brush gives much more satisfactory operation. It is suggested that for ordinary commutator work the brush width should not be greater than 1½ in., and the thickness should be that required by the commutating conditions, but preferably not more than 1 in.

Brushes of the slide type are immensely superior to the grip type, owing to their lower inertia and consequent ability to respond readily to inequalities in the collector. An exception may be necessary in the case of induction motor brushes which are lifted after the motor has been run up to speed; but in this case the need for a slide type is largely eliminated by the fact that the brushes are only in service for a few moments at a time.

A brush should be reduced as far as possible to its simplest elements, and all unnecessary fittings avoided which add to the inertia of the brush and are seldom essential to its satisfactory operation. If any protection is required on the top of the brush it should take the form of insulating material; this is lighter than metal and is more effective for the purpose, as the excessive wear sometimes produced on the top of a brush by the pressure finger is more an electrical effect than a mechanical one. Solder should be avoided whenever possible. Certain classes of brushes cannot be made to possess the requisite characteristics without making them comparatively frugile; in such cases an envelope of copper materially strengthens them. Coppering, however, has its attendant disadvantages. The brushes must have sufficient clearance in the holders over the coppered portion, and therefore an undesirable amount of clearance over the uncoppered portion. Copper plating on a brush also encourages the current to pass directly from the sides of the brush to the holder. This causes rapid wear of the brush boxes, and the excessive clearance resulting therefrom prevents a brush from bedding perfectly on the collector if it does not actually lead to serious chattering and breakage of the brush. In the author's opinion it is almost impossible to exaggerate the importance of making the mechanical conditions as perfect as possible. Half the battle is to maintain intimate contact with the collector. The total clearance in the holders should not exceed, say, 0.2 mm. in the circumferential direction and 0.3 mm. in the axial direction, and these figures may be halved with advantage. The brush boxes should be deep and should have four complete sides with unbroken surfaces. Flimsy holders are poor economy; they are usually very inaccurate, and vibrate excessively under adverse conditions. Substantial cast holders are a great assistance to satisfactory operation.

For high-speed work the majority of constructors have adopted the type which embodies a spiral spring directly behind the brush. This type possesses the additional advantage of taking up a minimum amount of room in the circumferential direction, and therefore affords a minimum of assistance to an arc to maintain itself between spindles of opposite polarity.

Every brush should be fitted with flexibles proportioned to carry full current with a reasonable margin for overloads and unequal distribution of load, but they should not be larger than is necessary, especially if they are short. A shoe-type terminal should be used which can be positively clamped under the head of a screw. Pin-type terminals cannot be recommended.

For many years traction brushes were rarely, if ever, fitted with flexibles, the pressure finger and box sides being depended upon to carry current. The reason for this seems to have been largely due to the difficulty of providing satisfactory means of securing the terminal end of the brush to the holder. This has been solved by a form of spring grip which can be operated in inaccessible positions, and has no parts that can work loose and cause damage inside the motor. The use of flexibles increases the life of both brush and commutator, wear at the top of the brush is prevented, and an all-round better performance is obtained.

(To be concluded.)

Discussion in London.

Mr. C. H. Wordingham said the subject was a most important one, both to makers and users of brushes. There was a sub-committee, of which the author of the paper was a member, at work at the present time on the standardisation of brushes. The work of this sub-committee should help greatly to improve the haphazard methods of purchasing brushes that were in use at the present time.

Mr. A. Constable regretted that although there were a number of brush experts their knowledge was not always interpreted in the drawing office. It was very difficult to find a really true commutator, and he thought that all the troubles and curious phenomena that were encountered were the results of untrueness of the commutator; that might also explain the rapid drop of the coefficient of friction. He could not say whether the film of air that the author had explained existed under the brush or not. If it did, then he could not see how any current would pass at all. He found it difficult to understand contact drop, and he maintained that there was no such point as the author had mentioned below which no current would pass. So long as the brush was in contact current was bound to pass, even without any pressure on the brush at all. He thought that the suction effect which the author mentioned might be similar to the attraction between two highly polished metal surfaces. Regarding the size of brushes, he certainly thought large brushes were undesirable, because they were difficult to bed properly; on the other hand, small ones should not be allowed to lead to the multiplication of parts. Standardisation was desirable, but difficult to accomplish, though it should not be difficult to secure uniformity of quality. He advocated that all brushes should have distinguishing marks of some kind, so that when they were being replaced from the works' stores there could be no chance of mistakes being made. Two brushes might appear to be identical from all outward appearances, but in reality they might not be so. Recessed mica gave trouble; he knew of one firm which had to go back to smooth commutators on account of trouble experienced due to oil getting in the slots, although the machines would have run better with undercut commutators. If the mica was recessed cleanliness was absolutely essential, or trouble would be experienced. The ordinary method of bedding brushes was by no means good. When a sheet of emery paper was drawn backwards and forward under the

brush the curve given to the face of the brush was not the true one; it would be a curve having the radius of the commutator plus the thickness of the paper. Under such conditions the machine would have to run for at least three hours before the brush assumed its correct shape. With regard to copper pitting, he did not think the action could be termed an electrolytic one, because there was no electrolyte. He thought it was really due to very minute sparks, which could not be seen at all, jumping across from the commutator to the brushes. He did not believe in lubrication; if carried out the result was the introduction of a film of resistance under the brush which would still further increase the difficulties.

Prof. J. T. MCGREGOR-MORRIS described the paper as being a very valuable one; it gave certain definite facts upon which a solid foundation could be built. There were one or two points about which he would like to have more information. First, how had the author measured his contact drop; was it by the ammeter and voltmeter method? Also, did his fig. 1 refer to a collector ring, to a commutator without an armature, to a commutator with an armature, or to a complete machine? Referring to some experiments that he had made, he said he had quite failed to find any such critical point as mentioned by the author below which no current would pass. He asked the author whether he really meant that there were no sparks at all when he used the word "sparkless." It was extremely difficult to determine whether such a condition existed, and if it really was so then the theory of the thing would be different. With regard to the volt-ampere curve, he spoke of experiments that he had carried out with a microphone, and said that he believed the theory of the microphone also applied in this case; he thought the theory was the same whether there were many or only one contact. He asked the author whether he had taken his tests on a running machine or not. It was difficult to take such measurements on a machine when on load, but unless that was done the results would not be applicable in practice.

Mr. R. ORSETTICH said he did not think it was quite so difficult to produce a universal brush as some people thought. He had known of a certain type of brush which, if it could not exactly be styled universal, at any rate went very near being so, and it was a pity that it had not been further developed. He called attention to the superiority of twisted over braided leads; he always specified for twisted leads. When such leads became overheated they could be easily untwisted, and so offered greater cooling surface without interfering with the running of the machine. He spoke of the defective methods of fixing leads to brushes, and said he knew of brushes being split due to the unequal expansion when a metal pin passed through the brush. Personally, he favoured the oscillating slip-ring, as it tended to keep the brush in good condition. He did not think a brush could be expected to collect heavy current if it was lubricated, and it was therefore desirable to eliminate artificial lubrication entirely.

Mr. J. MCI. CATER regretted that he was unable to speak at any length at the time, but he would have pleasure in putting his contribution to the discussion in writing. With regard to the standardisation of brushes, he thought that should come in the first instance from the designers of electrical machinery, and brush-makers would only be too glad to follow. He was quite in agreement with the author as to the impossibility of developing an universal brush.

Mr. H. BRAZIL was of the opinion that undercutting the mica was the better practice, but care should be taken not to cut too deeply. He had seen much trouble caused by oil vapour getting in between the segments and setting up short circuits, which necessitated the commutator being remade. He was greatly interested in the partial vacuum which the author had explained existed under the brushes; that would increase the coefficient of friction. He uttered a warning against measurements that were taken in a laboratory; they were not the same as measurements taken under working conditions, and would not be of much value in practice. He emphasised the importance of small detail in brush work, and said that the sliding type was the correct type of brush to use. Brush holders and boxes should be of a very solid type, and the latter should have as small a clearance as possible. Flexible leads should be of as large a section as possible, and it was desirable to provide three or four of them instead of the usual one or two. He had found it very difficult to prevent slip-rings becoming grooved due to different parts of the brush being harder than others, but, on the whole, grooving was not objectionable as it gave greater contact surface. The end-play remedy for grooving was not a good one.

Mr. P. R. FRIEDLAENDER spoke of his experience with small motors, which, when running at high speed, threw the brushes off the commutator. This was entirely a mechanical defect, and it should be possible to find some way of remedying it. He also referred to brush leads and the means of applying pressure to brushes; springs for the purpose were not always as effective as they should be, they often prevented the brush sliding properly, so that it could not follow the surface of the commutator and maintain proper contact.

Mr. H. K. WHITEHORN, referring to the author's tests, drew attention to the difficulty of obtaining accurate results with a machine on load due to the flow of circulating currents. He emphasised the great importance of giving proper attention to the mechanical points in the design of brushes, and also to the proper spacing of brush-holders in practice. When mica was undercut great care should be taken to do it properly, or else it was better left alone altogether. He was of the opinion that a small, narrow brush was to be preferred, and he thought a good deal to improve matters could be attained by a proper selection of brushes.

Mr. LL. B. ATKINSON referred to the brush patent he had taken out at the age of 22 years, and to his early experience of brushgear. He had not even yet been able to make up his mind whether the carbon brush was a blessing or a curse. It was a very simple solution of a difficult problem, but its efficiency was low, and from the point of view of commutation he did not think a worse method of collecting current could be devised. The question of contact drop across the brush was one upon which he still had doubts, in spite of what the author had said, but it was a question that required to be settled. He was in agreement with the remarks made by Prof. Morris, that the paper was a foundation upon which much good work could be built.

Mr. S. A. POLLOCK took exception to the author's statement that, nominally, commutating poles produced a flux proportional to the load, but actually they did not. Such a statement was incorrect. He said it appeared to be the author's general opinion that designers were "hit-and-miss" sort of people. If the author had dealt with modern machines he thought that some of his statements would have been worded very differently. He said there should be a constant voltage drop from the tip to the heel of the brush. It would be difficult to standardise the size of brushes, but he saw no reason why all brushes should be of one class. He knew of cases where it had been desirable to change the brushes, but it was not for reasons of commutation. He would like more data on the rates of wear of slip-rings given in the paper, and could the author say what the rate of wear of a copper-graphite brush under the same conditions would be? He agreed that an air film did exist under the brush, although it might be only a very thin film. He did not think such a film would affect the contact drop very much because the heat generated would rarify the air, and so wash out more of the film. He agreed that a large brush was bad practice, but the size should be kept as large as possible, so as to reduce the cost of brush renewals.

Mr. RUPERT S. ALLEN said that standardisation was very desirable; the number of grades of brushes should be reduced. He did not think the paper had taken sufficient account of inertia. They had heard something of brushes jumping and bumping; it was quite essential that the brush should be able to respond immediately, and when these condtions were fulfilled better results would follow.

The AUTHOR, in reply to some of the points raised, said that his fig. 1 was taken on short-circuit by the ammeter and voltmeter method. When the commutator was at rest the curve ran down to the origin. To obtain fig. 6 the brushes were tested individually on a slip-ring, and were afterwards checked. Perhaps it was not quite correct to term the copper pitting action an electrolytic one, as there was no electrolyte, but it was something very similar. The alternative explanation put forward by a speaker he did not think would fit in, as the action was confined to the negative brush. It was advisable to use one brush in place of two whenever possible, because when two were used one invariably wore away quicker than the other. With regard to external lubrication, he could only say that where it was found necessary it could only cast a reflection on the makers of the brushes.

FREQUENCY CONTROL.*

By HENRY E. WARREN.

THE ordinary method of measuring frequency is by means of a meter which indicates upon a scale the value at any instant. The common method of regulation has certain faults which hitherto have not been emphasised because they have not been obvious, and because there has been no better way of accomplishing the regulation.

A new method of maintaining frequency, which has been in actual use during the past two years by a few of the largest power companies in New England and New York City, differs radically from the conventional plan. No frequency meter of the ordinary type is required. Instead, a device which conveniently and accurately compares the integrated alternations with elapsed time serves as a guide to the operator for adjusting the speed of the turbines. This device is comparatively insensitive to the instantaneous value of the frequency, but shows its average value with the very greatest precision.

The instrument itself, known as the Warren master clock, consists of a complete pendulum clock with two dials. The lower one serves merely to indicate the time of day in the conventional manner. The upper dial, of larger diameter, has a hand which revolves once in five minutes. The clock movement is provided with novel electrical means for regulating the rate with very great precision. The pendulum rod is made of "invar," so that the clock is practically unaffected

* *General Electric Review*, November, 1918. Abstract.

by temperature changes. It is an extremely accurate time-keeper, and can be regulated to run with an error not greater than a second or two per week.

Mounted upon the upper five-minute dial of this clock is another hand which is gold-coloured to distinguish it from the black clock hand. This gold hand is wholly independent of the clock movement, but is driven through gearing by a small self-starting synchronous motor, illustrated in fig. 1. This motor is connected permanently through any convenient potential transformer to the alternating-current system. The gear ratio between the gold hand and the motor is such that at normal frequency, for example, 60 cycles, the hand will revolve once in exactly five minutes. Incidentally, the synchronous motor keeps the pendulum clock movement constantly wound at uniform tension.

After the Warren master clock has been started and regulated, the gold and black hands on the five-minute dial are set over each other, and the operators are instructed to adjust the speed control switches of the turbines occasionally, if they observe any tendency of the gold hand to gain or lose with respect to the black hand.

It is surprising to observe how slowly these two hands

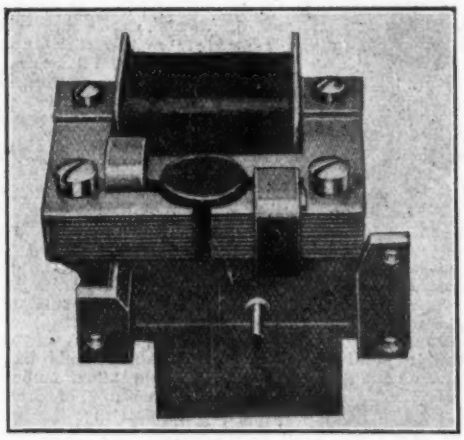


Fig. 1.—Self-starting Synchronous Motor for Driving Synchronising Hand (Full Size).

change their relative positions, after the speed of the turbines has been correctly adjusted. This is because the turbine governors maintain the average speed very accurately indeed, and the momentary fluctuations in speed, which are just as likely to be above as below the average value, cancel out and do not perceptibly affect the relative position of the two hands. The clock gives a true indication of the average value of the speed, it serves therefore to establish a correct base line for the frequency.

From the standpoint of the operator there is a considerable advantage in eliminating unnecessary and objectionable

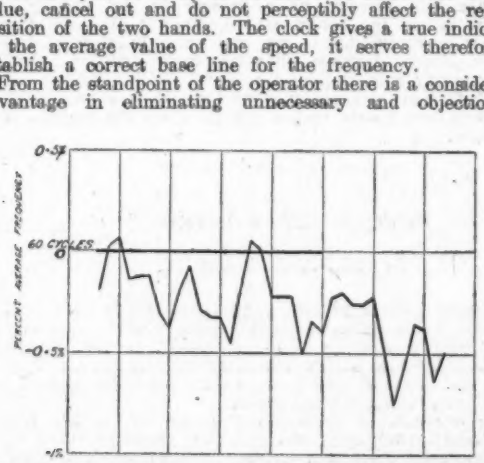


Fig. 2.—Curve Showing Improvement in Daily Average Frequency Secured by Warren Master Clock.

manipulation of the speed-control devices in a continual effort to follow fluctuations in speed which are only momentary.

The new method practically eliminates the effect of all instrumental errors due either to calibration or temperature. The average frequency measured over periods exceeding 24 hours can easily be maintained over periods exceeding a hundredth of 1 per cent. of its true value.

The scale of the instrument is so extended by the integrating process that close reading is wholly unnecessary.

Since October, 1916, the frequency of the Boston Edison Co. has been controlled by this improved method. The original Warren master clock has been running continuously 24 hours each day without repairs of any kind and without attention, except for daily comparison with Washington time signals and infrequent regulation. All the alternating current supplied from this station to 35 cities and towns and more than 50,000 customers has been controlled in this manner.

The improvement in frequency regulation may be seen by referring to fig. 2, where the curve shows the average frequency for 24-hour periods during the month before the installation of the master clock, and the thick straight line indicates the frequency thereafter. The curve and the straight line are on the same large scale. The variations of the curve are probably due more to temperature changes than to any other cause, and it is likely that they would appear materially greater if measured through summer and winter. The straight-line, if continued to the present day, would probably show no variations large enough to be plotted on this scale.

It may be argued that the curve is acceptable commercially, but there can be no doubt that in the long run those manufacturers who use electric power, especially textile mills, gain materially by eliminating errors and variations in the average frequency, even as small as one-half of 1 per cent. This must be so because the speed of all motors, and, consequently, the output of the mills, varies directly with the frequency. One-half of 1 per cent. would mean 50 dollars per day to a mill with a daily output worth ten thousand dollars.

The Warren motors, shown in fig. 1, are very small, and practically foolproof. They consume about two watts, and will bring their load from rest up to absolutely synchronous speed within a second or two. One of these motors may be substituted for any clock mechanism with a certainty that it will run at the same rate as the master clock at the central station.

This means that any power company using the improved frequency control may eliminate all the troublesome clocks in graphic instruments, maximum demand meters, time switches, and similar devices by substituting the small Warren motors, which take up much less room and are many times more powerful. A very considerable saving can be secured in this way, particularly with demand meters which are widely distributed. The cost of weekly winding disappears, and the maintenance expense is greatly reduced, and much more accurate and reliable records are secured. It seems quite certain that for large systems the gain in re-equipping graphic instruments and demand meters will alone pay a generous return on the very moderate cost of adopting the new method. Motor-driven time switches for controlling multiple street lamps and many other purposes suggest very important possibilities for the future.

Whenever two systems are to be interconnected they must first establish the same frequency. This result can be accomplished with ease by the improved method of control.

ELECTRICITY SUPPLY PROGRESS IN WAR TIME.

(*Continued from page* 616.)

AYR.

During the war the Corporation of Ayr (Mr. R. Marshall, burgh electrical engineer) has converted its alternating-current supply system from single-phase, 60 periods, to two-phase, 50 periods, and has increased the capacity of the generating plant by 1,500 kw., making a total of 2,600 kw. In the same period, the horse-power of motors connected to the mains has increased by over 100 per cent., and there is every prospect that, when Government restrictions are withdrawn, there will be a considerable demand for additional supplies of electrical energy for all purposes.

ABERDEEN.

The Corporation of Aberdeen (Mr. J. Alex. Bell, city electrical engineer) has almost doubled its annual output in the four years from 1914 to 1918. The following table summarises the increase in output and connections during the period in question :—

	July 31st, 1914.	July 31st, 1918.
Total units sold	9,663,054	17,408,147
Units sold for power and heating	4,692,626	12,025,681
Total H.P. of motors connected ...	8,441	16,855
Number of motors hired out ...	677	864
H.P. " " ...	3,776	6,077
Total heating and cooking connections	1,202 kw.	2,177 kw.
Total number of hired heating and cooking appliances ...	961	1,598
Total number of hired radiators and fires	351	688
Total number of hired irons ...	364	628

To deal with the increased load a new 5,000-kw. turbo-alternator, complete with surface condensing plant, was put to work in the early part of this year. To accommodate this set it was found necessary to extend the engine-room buildings a matter of 40 ft., as the load was such that it was

found to be unsafe to remove three 420-KW. reciprocating sets, which would otherwise have had to be done. A further 5,000-KW. turbo-alternator is on order for delivery in the spring of 1919, and this is to occupy a position in the main engine-room in place of the above mentioned old reciprocating sets, which have now been disposed of. The plant capacity will thus be raised from 8,380 to 18,380 KW. A 1,000-KW. motor-converter has been installed, and a further one is on order.

The boiler-house plant has been increased by the addition of two Babcock & Wilcox water-tube boilers of 18,000 lb. each, and to deal with coal stocks a telpherage system has been installed. Two new electrically-driven pumps have been installed in the pump chamber on the river bank, and a new pipe has been laid to the works for condensing purposes.

A new sub-station for improving supply in the docks area was put into use in November, 1917, and contains one 500-KW. motor converter and one 400-K.V.A. static transformer, with the requisite E.H.T. and L.T. switchgear. Four new static transformer sub-stations of a total capacity of 1,700 K.V.A. have been built and equipped in connection with supply to various works, while two existing sub-stations have been enlarged by a total of 750 KW. of rotary and 400 K.V.A. of static plant.

The opening of these new sub-stations and the rearrangements of the cable system involved the laying of 5.87 miles of E.H.T. feeder and 5.19 miles of L.T. feeder; 8.14 miles of distributor have also been laid.

The principal war industries have been the building of ships (largely Admiralty trawlers), manufacture of shells, weaving of Army cloth, making-up of Army clothing, and tinned rations. Most of the firms engaged on these already used electric power; these have enlarged their plant, while others have taken supply who did not previously do so. Thus one large firm of engineers, which was previously not a consumer at all, has installed over 900 H.P. of motors, an electric steel furnace requiring 750 to 1,000 KW., and a 40-K.V.A. electric welding plant. A firm of shipbuilders which used electricity to a limited extent has added over 800 H.P. between extensions and replacement of old steam plant. Another firm of engineers and shipbuilders has added over 400 H.P. to its previous installation, while a new shipyard started during the war has 350 H.P. of three-phase motors, and no other form of power. A large firm of jute and flax manufacturers has a complete electrical equipment of over 1,300 H.P. in a new mill, while a firm of woollen cloth manufacturers has added 325 H.P. to its previous installation, and has between 200 and 250 H.P. yet to go on.

A bakery and meal mill has changed over from steam to electric driving, with a total of 175 H.P. of motors. A paper works has put in 165 H.P., and has further plant awaiting erection. A chemical works has put up a new plant for the manufacture of superphosphate which requires 130 H.P., and there have been many installations of smaller size.

Aberdeen has not been without its share of new industries. The principal and most interesting is that of electric steel making, one firm having installed a 3½-ton furnace with transformers of 900-K.V.A. capacity. Another interesting departure is the building of concrete barges. The paper makers have taken up some new lines, and while one firm has developed the manufacture of paper from sawdust, another firm has turned its attention to the production of photographic papers. In a smaller way there is toy-making, and one firm is doing its best to capture a share of a trade formerly almost entirely in German hands.

REDDITCH.

The Urban District Council of Redditch (Mr. R. N. Mayne, electrical engineer) originally commenced supply 19 years ago on the single-phase system at 70 cycles for lighting purposes; but there has been a steady demand for electric power which the early type 70-cycle machines, working at a power factor of under 0.5, were unable to cope with, eventually failing altogether. In 1913 the plant had a total capacity of 665 KW., and was carrying a day load—practically all power—of some 450 KW., which increased in the evening, due to the lighting load, to a total of 640 KW. It became evident that if the plant in the industrial district of Redditch was to be driven by electric power and not by gas very drastic alterations in the method of generation and supply were necessary. Ultimately it was proposed to adopt a three-phase system of generation and distribution, but it was not until after the outbreak of war that contracts were placed for the new plant.

The Birmingham Small Arms Co., Ltd., Messrs. Herbert Terry & Sons, Ltd., and other large manufacturers entered into agreements for bulk supplies for power and light, but, although matters were accelerated as much as possible, it was not until September, 1916, that a supply of three-phase power was available. This delay, unfortunately, resulted in the loss of the cream of the war power peak, gas engines taking up the drive for essential war supplies.

The new plant installed consists of two 1,000-KW., 3,800-volt, 3-phase Parsons reaction type turbo-generators, with electrically-driven auxiliary plant, and a Heenan & Froude wet-air filter. Additional steam is provided by a 13,000-lb. Babcock & Wilcox boiler, which unfortunately had to be put down in a temporary position, further extensions to the old boiler-house being prevented by the destructor house at one end and a cooling tower at the other. This arrangement has been a very expensive one, as it took two sets of firemen per shift, and two coal-storage bunkers had to be stocked. New H.T. and L.T. 3-phase, 4-core feeders and distributors were laid to convenient centres, the H.T. cables feeding into new sub-stations, fitted with modern B.T.H. truck-type switchgear, and B.I.W. switch-fuse L.T. units; 0.2 4-core, L.T., 3-phase cables feed into the surrounding single-phase underground sub-stations, the original single-phase distributors being balanced as nearly as possible between the phases and neutral. This arrangement has done away with the high-pressure fuse and switchgear and transformers, always a dangerous and unsatisfactory combination in underground sub-stations.

The two problems which presented themselves on the change-over from 70 to 50 periods were: The correct registration of consumers' meters, and the reduced speed of the one-phase motors. The meter department required overhauling, and a new building was put up for this purpose, equipped with modern testing arrangements.

It has not been possible entirely to do away with the running of single-phase machinery, and for this purpose two motor-alternators of 150 KW. and 300 KW. respectively have been put down. Normally these are motoring on H.T. single-phase supply, as there are a number of large consumers having their own H.T. transformer sub-stations giving a L.T. supply to their works.

The three-phase has proved so reliable and satisfactory that the single-phase motor has been displaced by the three-phase in a number of cases by consumers; in fact, the demand has increased so rapidly—in 1916 the units generated were 1,648,733, for the year 1918, 3,792,286—that it has been necessary to order another 3,000-KW. turbine and auxiliaries; the engine room will be extended and will take the place of the temporary boiler house. A new boiler is to be put down at the same time.

The opportunity will be taken to bring all the boilers under one roof, the old destructor house being done away with to enable this to be done, and with overhead coal bunkers, economisers, and induced-draught fans, considerable economies are to be looked for.

The needle and fish hook trade is the staple industry of Redditch and district, together with a newer but important industry of springs, bicycles, and motor-bicycle manufacture. These trades require a number of isolated shops, for which the electric motor is particularly suited.

Redditch has for the past four years been engaged solely on war work, but the machines are rapidly being diverted back to their normal work, for which there is a great demand.

(To be continued.)

THE SUPPLY OF SINGLE-PHASE POWER FROM THREE-PHASE SYSTEMS.

Prof. Miles Walker read his paper (an abstract of which appeared in our issue of December 13th, 1918) before the North-Midland Centre of the I.E.E. at Leeds, on December 10th.

Mr. R. H. Campion, the Chairman, observed that they were much indebted to Dr. Walker for his up-to-date paper; he ventured to prophesy that it would become a classic one so far as the Institution was concerned. Some of them had been keener to get electric furnaces on to the mains than in thinking about the best way in which they should be employed. The author's paper on this subject was well worth careful study, though perhaps it would bring back again one of the famous old battles of the past, as in the paper the single-phase furnace was most strongly and ably advocated, and one wondered whether the rotating balance transformer would be able to withstand all the big loads which were thrown on and off the furnaces without flashing over. He understood there were several towns where only three-phase furnaces were allowed on the mains.

Mr. Simpson remarked that he had read the paper with very great interest from the point of view of supply rather than from that of the actual user. He thought Dr. Walker had justified the points he had set out to cover. The Americans had some very interesting experiences five or six years ago; they experienced their first troubles with the heating of machines giving the single-phase supply from three-phase generators. He would like to know whether Dr. Walker would in the case of an 11,000-volt supply or more—say, in the case of a 400-K.V.A. balancer—put in windings for that voltage or prefer to step down to a low voltage on the machine. If that was so, one would have to consider the additional cost for such a case. Another point was whether Dr. Walker would propose to run several furnaces in parallel off the same piece of apparatus and the balancing transformer? As he (Mr. Simpson) looked at the matter, the stabilising advantage which Dr. Walker got at present by keeping the balancer transformer as one unit would be lost.

Mr. Brown said that the apparatus might be useful for electrical welding apart from electrical furnaces. He knew a

good deal was shortly to be done in the way of electric welding by alternating current.

Mr. Imbray was of the opinion that as regarded single-phase work they had to consider the possibility commercially. When a man was asked to spend £2,000 on a small installation for the addition of a rotary-converter and balancer he looked a long time at the proposition of installing a balancer. From the point of view of an electrical engineer, the true science of doing a thing was to do the thing most effectively at the least capital outlay without in any way depreciating the work done.

Mr. Townley was of opinion that with every three-phase furnace with bottom connections the supply authority had got to allow for unbalanced load. A point to remember was the size of furnaces that could be dealt with by a particular size of plant. The size of the furnace should not be more than 15 per cent. of the size of the plant running in the station. That was found to give very successful results. With a furnace of 25 per cent. of the capacity of the plant running in the station very bad results had been obtained.

Mr. Laing agreed with the Chairman that the paper was likely to be a classic on the subject. It would be interesting to watch developments in the future to see if Dr. Walker proved to be a wise prophet. Even if they had the battle of the phases over again it would be on a subject of primary importance, and would be of great interest to all concerned in the electrical industry. It was important to point out that so long as one was within 20 per cent. of the load of a station one could with safety use one-phase power only for particular work.

Mr. Selvey said he would like Dr. Walker to say something bearing on the use of a single phase for railway electrification.

Prof. Miles Walker, replying to the discussion, said that many points of interest had been brought out. As regarded condensers, there was no real limit to the output if one could get enough to pass the condenser. Of course, one was always a little afraid with condensers. The voltage was across a small thickness of dielectric, and although it might be found in practice that it did not get hot, still there would always be some difficulty in using condensers on high voltage. In the future they might have condensers sufficiently cheap to work them at a very low voltage gradient. With regard to the powers of furnaces, there was quite a possibility that in the future they might go to thousands of kilowatts in furnaces, not only for steel melting, but also iron smelting, and, whilst at present it was not altogether a commercial proposition, yet there were so many advantages to be gained that the matter was very seriously under consideration by a number of people, although it might be some years before power became sufficiently cheap to make it worth while. With regard to losses on load, makers made a guess at the losses, and it was only a matter of guessing big enough to calculate the efficiency lower than the efficiency obtained, so that there was nothing in that. As to the question of 11,000-volt machines, that would depend on the size of the machine; it was possible to make thoroughly reliable windings for a large machine. If it was a small machine a transformer would probably have to be put in, which would be a drawback. An electric furnace could make such a tremendous lot of money in a year that it paid the capital cost, apart altogether from paying interest on the capital. It was quite possible to put furnaces in parallel. As to electrical welding, he had not considered the matter, and did not know enough about the characteristics required for welding. If one required a lot of electric furnaces it would be an advantage to have one's own power station, although he thought some of the power suppliers would be pleased to cut prices even then with them. In many stations power engineers would not allow a single-phase furnace to be put on their line. They were so nervous of having it short-circuited that even 10 or 15 per cent. would not have to go on their line without some transformer. As regarded the application of single phase for railway work, the supply required was always on such a large scale that there was no doubt it would be dealt with by generators of special design. He was not anticipating that there would be any great demand for balancers for electric railway work. The electric railways were so big that they would adapt special plant for their special purposes.

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

20,396. "Electromagnetic wave navigational systems." J. Robinson and J. E. Murray. December 9th.

20,411. "Electrically-driven vehicles." J. E. Stott. December 9th.

20,432. "Selective apparatus for wireless control systems." A. M. Low. December 9th.

20,452. "Sparking plugs." K. E. L. Guinness. December 9th.

20,459. "Telegraphic systems." V. E. Castelli & E. Frattola. December 9th.

20,474. "Signalling apparatus in telephone exchange switchboards." J. T. Hogarth. December 10th.

20,477. "Means for converting alternating current into continuous or direct current." E. H. Jones. December 10th.

20,482. "Manufacture of socket supports for electric lamp bulbs." Etablissements Belin. December 10th. (France, December 11th, 1917.)

20,486. "Electric lighting for stage, &c." E. Booth & N. R. Booth. December 10th.

20,502. "Safety devices for prevention of theft or interchangeability of electric bulbs or globes." W. H. Cox. December 10th.

20,518. "Rectifying X-ray systems." W. A. Winter. December 10th. (U.S.A., December 10th, 1917.)

20,543. "Induction coils." M. A. Codd. December 10th.

20,546. "Make-and-break devices for induction coils." M. A. Codd. December 10th.

20,547. "Devices of the vibrated diaphragm type for giving audible signals." M. A. Codd. December 10th.

20,561. "Electrically-operated gears." H. Leitner. December 11th.

20,564. "Means for mounting dynamos, &c., on motor cycles and driving same." C. W. Pidcock. December 11th.

20,569. "Electrical fire alarms, &c." R. Cawthorne. December 11th.

20,576. "Protective arrangements for electric distribution systems." J. R. Beard, Electrical Improvements, Ltd., & P. V. Hunter. December 11th.

20,602. "Electric switches." Electric control, Ltd., & O. Ellefsen. December 11th.

20,604. "Electric terminals for switches, &c." G. O. Donovan & W. Donovan. December 11th.

20,605. "Apparatus for electric protection against corrosion, pitting, &c., of tubes, ferrules, doors, &c., of surface condensers, &c." L. J. Kettle. December 11th.

20,619. "Trolley heads for electric traction." J. B. Parker & J. Smith. December 11th.

20,640. "Metallic electrodes for electric arc welding operations." C. J. Holslag. December 11th.

20,650. "Electric heaters for auto-radiators." J. D. Browder. December 11th.

20,685. "Casings, &c., for electrical fuses, &c." Cable Accessories Co., A. Crawford & F. H. Reeves. December 12th.

20,686. "Electrical fuses." Cable Accessories Co., A. Crawford and F. H. Reeves. December 12th.

20,713. "Portable electric starter for motor-car engines, &c." C. B. Cave-Brown-Cave. December 12th.

20,727. "Dynamo-electric machines." F. Alwynhaigh & British Thomson-Houston Co. December 12th.

20,746. "Electrical furnaces." F.I.A.T. Soc. Anon. December 12th. (Italy, December 12th, 1917.)

20,757. "Firing electric mines." J. L. V. da Cruz. December 12th.

20,759. "Magnetos." Compagnie Generale de Magnetos. December 12th. (France, August 31st.)

20,762. "Electric welding apparatus." Quasi Arc Co. & A. P. Strohmenger. December 12th.

20,784. "Magnetos for internal-combustion engines." E. G. Beken. December 13th.

20,793/4. "Electrical phase-converting systems." British Westinghouse Electric & Manufacturing Co. December 13th. (U.S.A., December 13th, 1917.)

20,813. "Electric change-over switches." Eversheds & Vignoles and J. C. Needham. December 13th.

20,828. "Sparking plugs." T. Antoine. December 13th.

20,832. "Dynamo-electric machines." E. Harrison. December 13th.

20,858. "Electric furnaces." J. Harrison. December 14th.

20,863. "Electric alternating-current slip-ring motors and short-circuiting and brush-lifting gear therefor." Mavor & Coulson, Ltd., & M. S. Moore. December 14th.

20,899. "Truck type electric switchboards." Johnson & Phillips & W. A. Walker. December 14th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

16,749. Electromagnetic clutches or brakes, more especially intended for the driving and change-speed gear of motor road vehicles. G. Pollard & Menco-Elma Syndicate. November 14th, 1917. (120,757.)

17,013. Indicator, electric alarm, and ignition cut-off apparatus for the lubrication systems of engines. A. J. Hill. November 19th, 1917. (120,762.)

17,172. Alternating electric current protective devices of the type adapted to operate on reversal of current. British Thomson-Houston Co. and E. B. Wedmore. November 21st, 1917. (120,775.)

17,398. Electrical connections of electric torches, electric pocket lamps, and other portable electric lamps. Efandem Co. & A. H. Williams. November 26th, 1917. (120,782.)

17,608. Automatic telephone systems. Automatic Telephone Manufacturing Co. & A. J. Ray (Automatic Electric Co., in part). November 28th, 1917. (120,785.)

17,612. Electric furnaces. E. Grammont. November 28th, 1917. (120,786.)

18,032. Controllers for electric motors. G. Ellison & J. Anderson. May 31st, 1918. (120,798.)

18 153. Electrode holders for arc welding purposes. P. F. Smith and V. S. Robinson. December 7th, 1917. (120,801.)

18,496. Engine starters. V. Bendix. December 13th, 1917. (120,806.)

18,641. Means for locking incandescent electric lamps to their holders. H. Smith. December 15th, 1917. (120,810.)

1918.

71. Alternating-current motors. A. C. Bell & T. R. Bell. January 2nd, 1918. (120,822.)

2,235. Electromagnetic switches. British Thomson-Houston Co. (General Electric Co., U.S.A.) February 7th, 1918. (120,829.)

3,188. Controlling mechanism for use in electrical installations. Soc. Anon. des Etablissements L. Bleriot. November 7th, 1917. (120,545.)

3 237. Electric controllers of the barrel or drum type. Veritys, Ltd., and W. G. Pipkin. February 23rd, 1918. (120,832.)

5,173. Commutator brushes of electric motors. Sykes' Interlocking Signal Co., W. R. & R. W. Tarrant. March 23rd, 1918. (120,842.)

9,750. Electric motor control systems. British Westinghouse Electric and Manufacturing Co. June 13th, 1917. (116,734.)

Reconstruction Problems.—Pamphlet No. 9 issued by the Ministry of Reconstruction deals with various points in regard to "Naval Demobilisation." The scheme is explained in the form of question and answer.